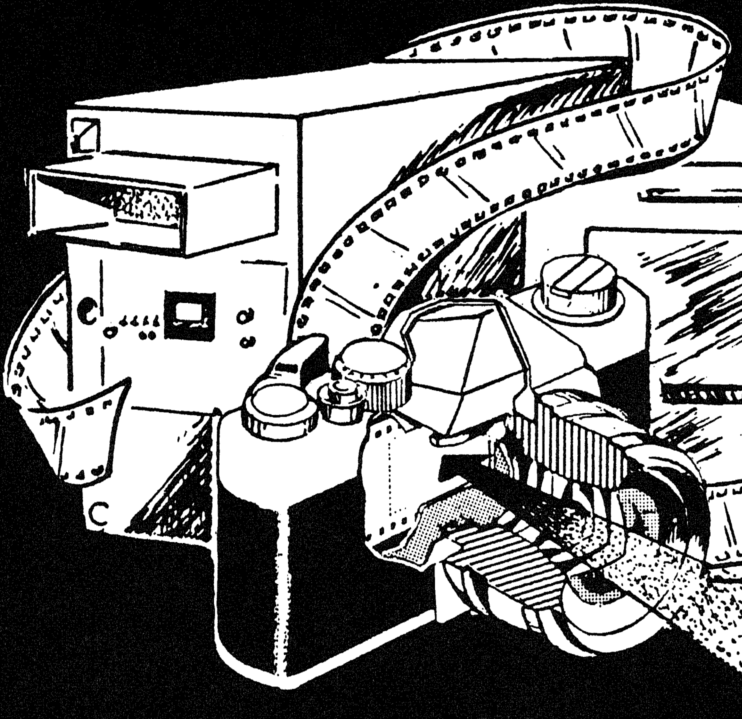
NAVY
PHOTOGRAPHER'S M
TRAINING SERIE



Although the words "he," "him," and "h
"she," "her," and "hers" are used in this ma
to enhance communication, they are
intended to be gender driven nor to affro
discriminate against anyone reading Modu
*Laboratory Procedures, Processing and Pri
B&W and Color Materials,* NAVED
373-03-45-83.

Naval Education And Training Pro

NAVY PHOTOGRAPHI
TRAINING SER

MODULE 3

LABORATORY PROCEDURES, P
PRINTING B&W AND COLO

NAVEDTRA 373-03-4

DEPARTMENT OF THE NAVY ★ CHIEF O ... ND TNG

PREFACE

Module 3, *Laboratory Procedures, Processing and Printing B&W and Color Materials* is one of the textbooks in the *Navy Photographer's Mate Training Series*. This manual was written especially for the men and women of the Navy and Naval Reserve.

Module 3 is a source of information on the principles of:

- *Laboratory Procedures*—The methods and techniques of chemical mixing, black and white film and paper processing, contact and projection printing, and negative and print finishing.

- *Processing and Printing Color Photography*—The methods and techniques of processing, printing, and finishing color negative and positive materials.

- *Machine Processing*—More and more "automatic" processing machines are being used to process black and while and color negative and positive materials. The methods and techniques required to use them successfully are covered.

- *Basic Maintenance Requirements for Photographic Laboratory Equipment*—The maintenance methods and techniques used on common photographic equipment. Troubleshooting and testing to determine problems, and keeping maintenance records.

- *Administration and Supply*—"How" standard stock photo supplies are ordered and how a photo stockroom is run. Including: the procurement of standard stock supplies for a photographic laboratory/unit; setting up and operating a photographic storeroom. Photographic and accounting records, reports, inventories, what they are used for and how they should be kept.

An NRCC (Nonresident Career Course) is included with this module. Information on course administration and ordering is available in NAVEDTRA 10061.

This module was prepared by the Naval Education and Training Program Development Center, Pensacola, Florida, for the Chief of Naval Education and Training.

Your suggestions and comments on this module are invited. Address them to Commanding Officer, Code PD, NETPDC, Pensacola, FL 32509.

1983

**Stock Ordering No.
0507-LP-373-0300**

Published by
NAVAL EDUCATION AND TRAINING PROGRAM
DEVELOPMENT CENTER

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON, D.C.: 1983

THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

CONTENTS

SUMMARY OF PHOTOGRAPHER'S MATE TRAINING SERIES

MODULE 1

Naval Photography, NAVEDTRA 373-01-00-81—A photographic history of the PH rating showing the role played by naval photographers from 1850 to the present; the present mission of naval photography; and a photographic look at present, typical, billet assignments.

MODULE 2

Still, Motion Picture, and Television Photography, NAVEDTRA 373-02-45-83—A complete look at principles associated with photography such as light, optics, cameras, and equipment which the PH must be familiar with to make practical application of the procedures and techniques. The subjects covered include: location photography, portrait and studio photography, television and motion picture photography, and aerial photography.

MODULE 3

Laboratory Procedures, Processing and Printing B&W and Color Materials, NAVEDTRA 373-03-45-83—This module covers the principles of processing and printing black and white and color materials. Some of the areas covered include: laboratory procedures, processing and printing color photography, machine processing, basic maintenance techniques for photographic equipment, and photographic supply and accounting.

MODULE 4

Audiovisual Productions, Quality Assurance and Specialized Photography, NAVEDTRA 373-04-67-83—This module brings to the reader some of the more advanced fields of naval photography. The subjects the reader will encounter include: slide presentation, motion picture and television production, quality assurance, planning aerial missions and specialized photography.

MODULE 5

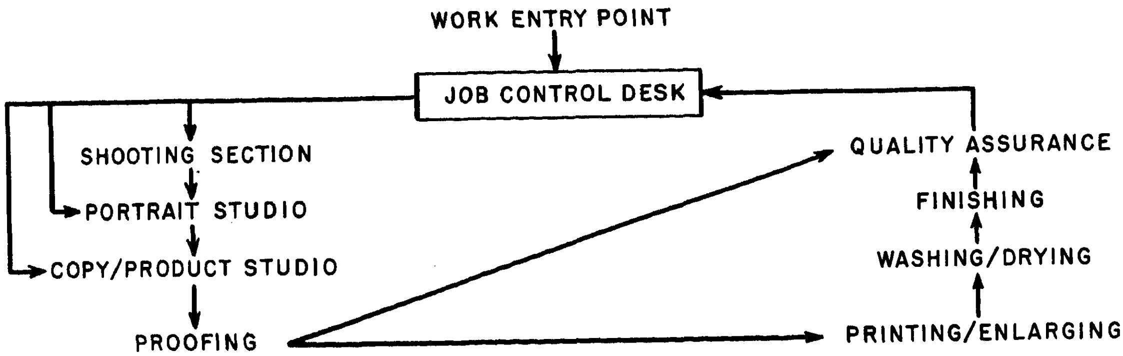
Photographic Management, NAVEDTRA 373-05-69-82—The methods and techniques of managing a photo lab including budget planning, lab organization, assignment and rotation of personnel within the unit, customer relation, and getting the job done.

CREDITS

The Naval Education and Training Program Development Center is indebted to a number of organizations and individuals for their assistance during the production of this module. While it is impossible to provide a complete listing of all the contributors, PHCM Ron Henline, Command Master Chief, Atlantic Fleet Audio Visual Command, deserves special mention for his critical reviewing of the manuscripts.

PHCM Tom Regina, USN

An attempt has been made to give credit for each photograph used in this text. Where the photographer's name is known it appears with the picture.



Production sequence.

involved in all the aspects of complete audiovisual production.

EQUIPMENT

The production equipment in your lab must be assessed from time to time in light of your current work and anticipated future expansion or changing mission. The choice of photographic production equipment should reflect the needs of your lab's mission.

> Allowance Lists, NAVAIR 00-35QP Series—published by ASO under the direction of COMNAVAIRSYSCOM (AIR-547)—contain authorized allowances of photographic equipment and materials for ships, aircraft squadrons, and other deployable units and shore activities.

Before considering the purchase of new equipment, you should first assess whether or not the new equipment can be justified. Should a capacity or capability to do a new process be added, or should the work be sent out, either to one of the fleet audiovisual commands or to the Naval Audiovisual Center, or even to a commercial photo lab? Some of the things to consider in making your assessment are the requirements for trained personnel, space, productivity, cost, convenience, and, of course, mission requirements.

The requirements for support equipment must also be considered. For example, consider the purchase of a new film processing machine. In addition to the processor, will new sinks, plumbing, and electrical service be required? Will additional storage space be required? How about specialized repair and test equipment? The processor may be of little or no use without accessories and support functions.

Any new or replacement equipment should be located so that it enhances the production rate. Your photographers should not have to line up to run their film through the new processor.

> The photographic work that leaves the laboratory should be of the highest possible quality. Each person should take pride not only in his own work, but in that of the laboratory as a whole, and ensure that only the best work possible is produced. Negatives should be properly developed, washed, dried, and captioned. All prints must be carefully inspected for improper contrast, scratches, and other blemishes, including uneven borders. Unsatisfactory prints should be destroyed and the negatives returned to the darkroom for reprinting. All prints must be properly stamped and captioned before being sent to the job order desk for delivery. *The reputation of naval photography is dependent on each person doing his or her best to ensure that only top quality work is produced.*

DARKROOMS

Darkrooms for processing film and making prints will vary in both size and layout according

to the space available, the type of process to be carried out (hand, machine, color or black and white), and the location of plumbing and electrical service.

In general, however, all darkrooms should be light-tight to prevent fogging of film and paper. The floors or decks should have chemical-resistant, nonslip, and resilient covering. The walls, contrary to what some may believe, do not have to be painted black. In fact, black is probably one of the least desirable colors to paint darkrooms. When walls are painted black, every splash of chemical will show, and the place will soon look dingy even with frequent cleaning. Another drawback to black is the fatigue it causes on the workers' eyes. Granted, you cannot see the color in the dark. But keep in mind—the darkroom is not always dark, especially the black and white print room. Instead of black, darkrooms should be painted light, pleasing colors such as light green, beige, or cream. However, when an enlarger is placed by a wall or within a three-sided printing station, it may be necessary to paint the wall and the panels black to prevent light reflections from the image beam to the sensitized material.

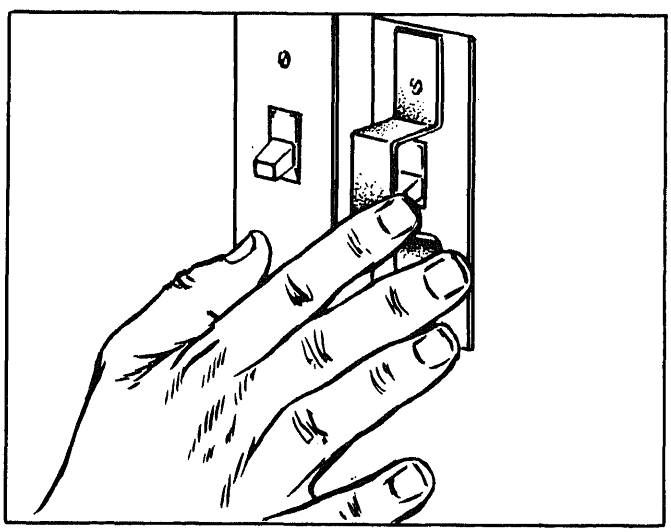
Darkroom ceilings should always be painted a smooth flat white. This will allow you to obtain the greatest amount of reflection from overhead safelights.

A locking device can be installed on the white-light switch in the darkrooms to prevent lights being accidentally turned on when films or papers are being handled.

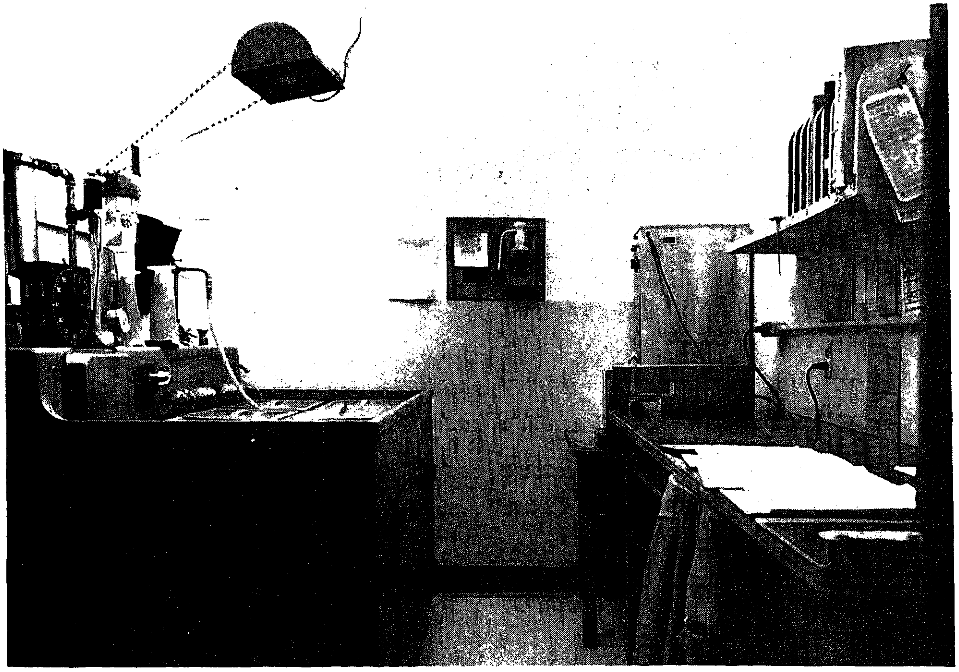
Film Processing Rooms

The sinks in film processing darkrooms should be equipped with duckboards (to allow water of the proper temperature to circulate under the processing tanks) and a way to adjust the temperature of processing solutions. When only a small amount of black and white hand processing is done, an immersion heater and a cooling coil through which cold water can pass will serve well. If a large amount of black and white or color processing is done, the processing solution tanks can stand in a bath of tempered water to keep them at the right temperature.

Because most of your film will be processed in total darkness, it is important to have a place for everything in the darkroom, and everything must be in its place. When in the dark, you will be working by feel. After you get used to a particular darkroom and its layout, you will be able to reach out in the dark and find any equipment you need, such as film hangers, film



White light switch guard



Black and white sinkline (hand) film processing room.

reels, tank lids, etc., but only when each is in its proper place.

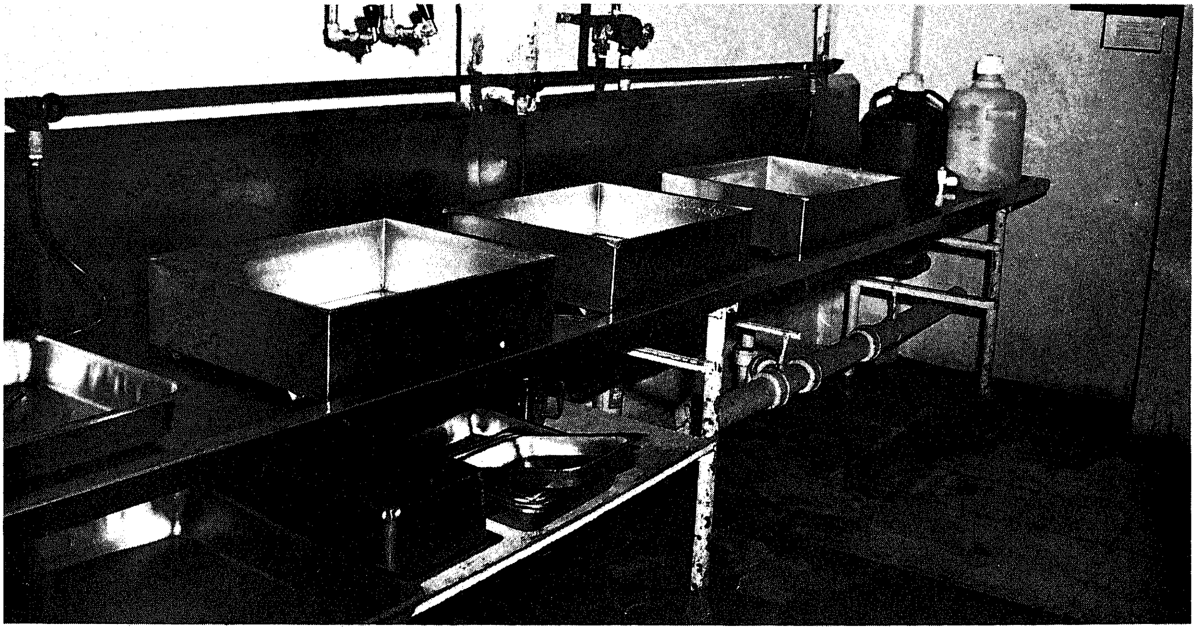
Black and White Print Room

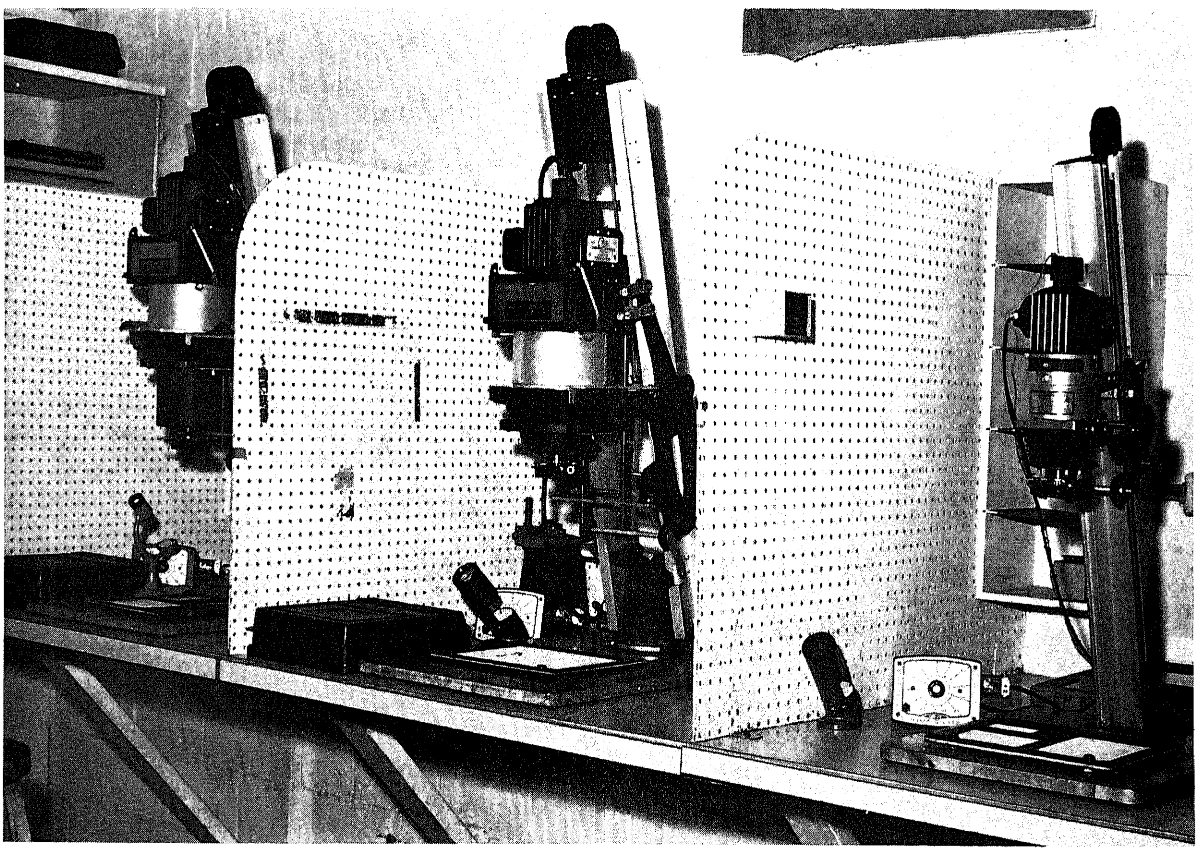
Black and white print rooms vary in size, from those for only one person who prints occasionally, to those large enough for several people to work throughout the day on several printing assignments simultaneously. Quantity print production is best carried out in a large darkroom where several printers can work at printing stations and "feed" the exposed paper into a processing machine or into the tray for hand processing by one or more "soupers" (the people who get their hands wet and process the paper).

BLACK AND WHITE PRINT ROOM SAFELIGHTS.—A black and white print room should be as well lighted, with safelights, as possible, both for the comfort and convenience of workers and for their safety. Most black and white print rooms are equipped with one or more sodium vapor safelights. The sodium vapor light source is a true monochromatic light and has the least effect on photographic papers, but is the type of light to which the human eye is most sensitive. These lights produce a relatively large amount of visible light which is most convenient for the print room workers. The advantages are obvious. A bright light is more pleasant to work with; equipment is easier to handle, accessories are easily located; and darkroom accidents are prevented. Always refer to the product carton or data sheet packaged with the light sensitive material being handled for safelight recommendations. Given here is a table of several common safelight recommendations.

Safelight Recommendations

Safelight filter	Color	Sensitized material which can be handled when a 15-watt light bulb is used not closer than 4 feet from the material
OA	Greenish/yellow	Black and white duplicating materials
OC	Light amber	Black and white printing papers
No. 1A	Light red	Kodalith materials
No. 2	Dark red	Orthochromatic materials
Sodium Vapor	Yellowish	Black and white printing paper





Black and white print room.

When the lab has more than one black and white print room, the lighting conditions should be the same in each. When the lighting is uniform from print room to print room with regard to the light intensity and the reflectivity of the walls and ceilings, workers can move from one print room to another with a minimum of inconvenience and loss in production quantity or quality.

Some printers like to examine their prints under a white light placed over the fixing bath. In a print room shared with other printers, this may be objectionable. However, if a long, cylindrical shade is placed around the light and it is hung close to the fixer surface and used with care, it should not disturb others.

Color Print Rooms

Color print rooms are basically the same as black and white print rooms. The one exception is that they do not usually have safelights. Color sensitized materials, as a rule, are always handled in total darkness.

In labs where several color printers are working separate printing rooms are necessary. A centrally located basket processor or the dark end of a roller-type processor can handle the work of a number of printers.

Print viewing light used over the fixer.

Security Darkroom

A security darkroom may be advisable for classified jobs, especially if other work or workers would be stopped or inconvenienced by the influx of classified work. If most of your production is mechanized, a security darkroom where hand processing is done may be particularly useful because classified work often requires special handling. A good location for this darkroom is adjacent to the copy studio, because much of the classified work done in Navy photo labs is copy work.

The equipment for a security darkroom should include basic processing and printing apparatuses: a sink, film processing tanks, print trays, an enlarger, and a contact printer. And of course, the door to the room must have a lock on both the inside and outside to keep unauthorized people out while classified work is being performed in the room.

Film Loading Room

The film loading darkroom need not be very large because the only thing you should do in a film loading room is load film. The room should never be used for film or print processing. Chemical dust from dried, spilled, or splashed processing solutions would be sure to get on the film and ruin it. A film loading room must be absolutely dark; it must be spotlessly clean, and nothing that generates static charges should be in the room.

A room which seems dark to the unadapted eye may in fact be unsafe for handling unprocessed film. To check for light leaks, close the door, turn out all the lights, and stay in the darkened room for at least 10 minutes. After your eyes have become dark adapted, you will be able to see even the slightest light leak. Ventilation openings and cracks below, above, and around the door will probably be the main source of light leaks. Ventilation openings should be masked with louvered boxes over the openings. Cracks around doors should be sealed with strips of foam rubber or other similar weather stripping material.

Darkroom Entry Ways

Small darkrooms such as film loading, film processing, and small-scale printing rooms may be provided with only one light-tight door. This door should have a small lock or bolt installed

on the inside which can be easily forced in an emergency.

Other larger, more productive darkrooms, especially those shared by several workers, should have a light lock, a light trap or curtains.

LIGHT LOCK.—A light lock is a small hall with two doors, one that opens into the darkroom, the other into a light room (usually the finishing room). The doors are usually opposite each other and equipped with an interlocking device, electrical or mechanical, that prevents one door from being opened while the other is open. All interlock systems *must* have a safety release so both doors can be opened in an emergency or when large objects must be moved in or out of the darkroom.

Either pocket doors or hinged doors or a combination of the two can be used in the light lock. The lock should be illuminated with an appropriate safelight.

LIGHT TRAP.—A light trap is usually installed as an entrance to a black and white print room. Because of their design, it is difficult to make rooms with a light trap totally dark. That is why they are not usually used for film loading or processing rooms or for color print rooms. Their greatest advantage is in the easy access they permit between light and dark rooms. They also allow the free circulation of air.

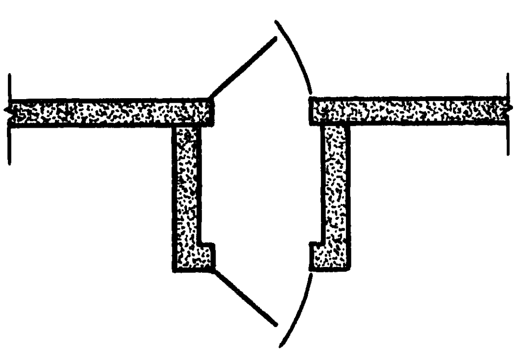
The interior walls of a light trap should be painted flat black. A light trap should not be placed close to a window or a light-colored wall. The safety to sensitized material depends on reducing the reflection of white light through the trap. A light-tight door should be placed in the center baffle of a light trap to facilitate the moving of large items in and out of the darkroom.

CURTAINS.—When there is no other way to block the light from the entrance to a black and white print room, curtains can be used. However, curtains cannot be used for film loading or processing rooms or for color print rooms. The curtains should be opaque. They should be made from a strong fabric which will withstand considerable abuse. Because the curtains quickly become soiled, two sets should be available—one to be used while the other set is being laundered.

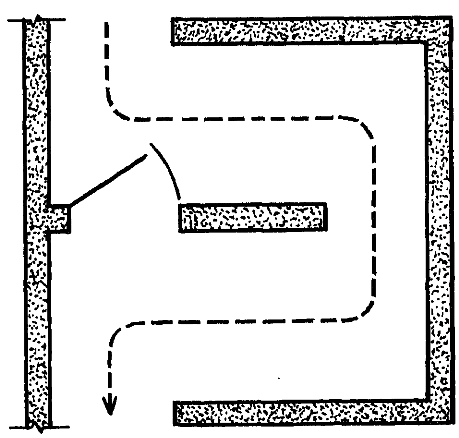
LIGHT ROOMS

The light rooms of a photographic laboratory are all other rooms that are not intended or designed for loading and processing film or making photographic prints. Some of the light rooms which may be included as part of a photo lab are drying rooms; a finishing room; copy, product, and portrait studios; chemical mixing rooms; storerooms; reception areas and offices; file rooms; editing and viewing rooms; bunk rooms; utility rooms; camera repair rooms; and heads and a crew's lounge. Many of these rooms may be combined into one or more spaces. For example, the copy, product, and portrait studios may actually all be in one room. The drying rooms are often part of the finishing room, and utility rooms and heads are sometimes one and the same.

With the exception of studios, light rooms often have windows. If windows are included in the studios, some means of completely blocking off light from them should be provided in order to control the studio lighting as the need arises. The walls of light rooms should be painted in light, pleasing, pastel colors. A two-tone design



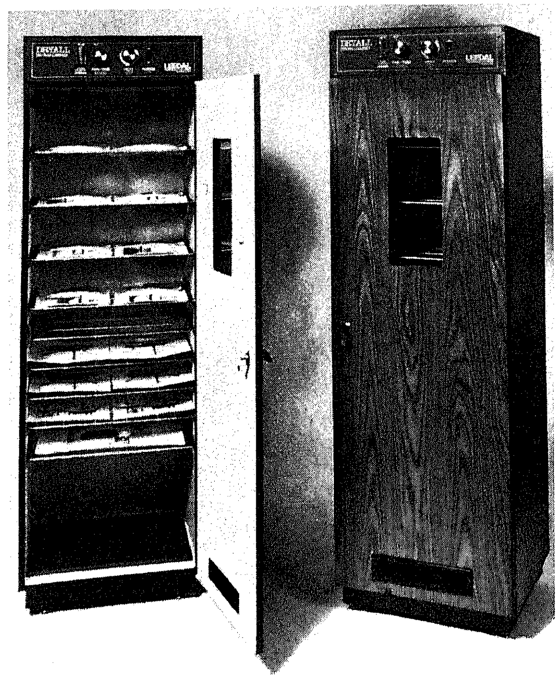
Two way light lock.



Light trap.

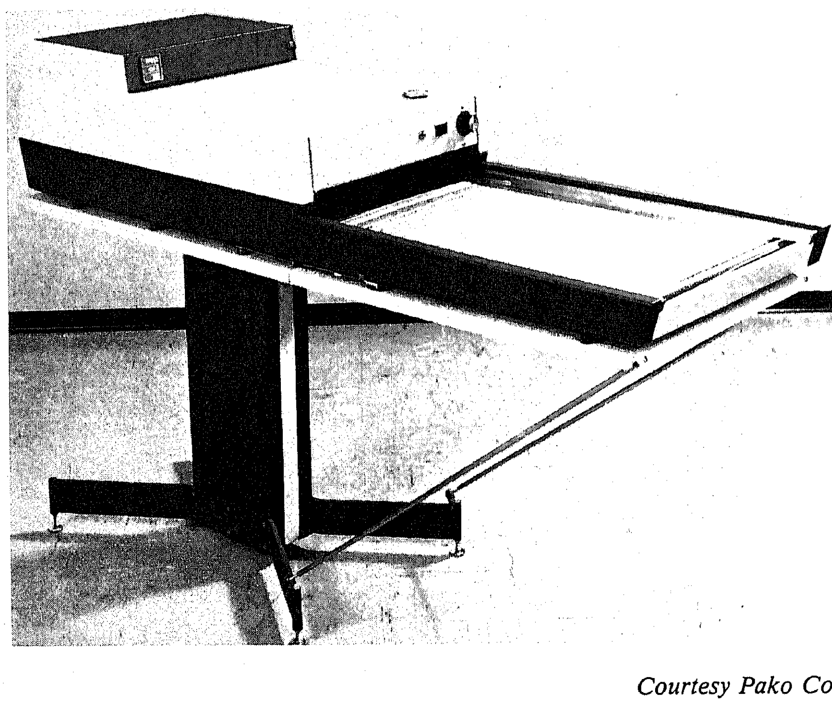
PH3 F. Maldonado

Film drying cabinet.



Courtesy Leedal.

Film/print drying cabinet.



Courtesy Pako Corp.

Resin coated print dryer.

helps relieve monotony. Where color prints will be evaluated, it is a good practice to paint the walls a neutral gray. This prevents the wall color or light reflected from the wall from influencing print evaluation. A light, off-white, beige, or cream color is best for studios. If strong colors are used in studios, light reflected from the walls may cause color casts which cannot be corrected in the finished color prints. Walls next to sinks, passthrough boxes, washers, and dryers should be painted with a gloss or semigloss oil base paint or with a gloss or semigloss acrylic latex paint. This permits easy cleanup of splashes.

The ceilings of light rooms, especially studios, are painted flat white.

Drying Rooms

A drying room is a space where negatives, transparencies, and prints, especially large prints, are dried. Large prints are often dried by hanging them from clotheslines in the drying room.

A principal requirement for a drying room, especially for negatives and transparencies, is a dust-free atmosphere. A drying room should be ventilated with rapid changes of warm, filtered air. The drying room temperature should be maintained at approximately 100°F, and a dehumidifier may be required.

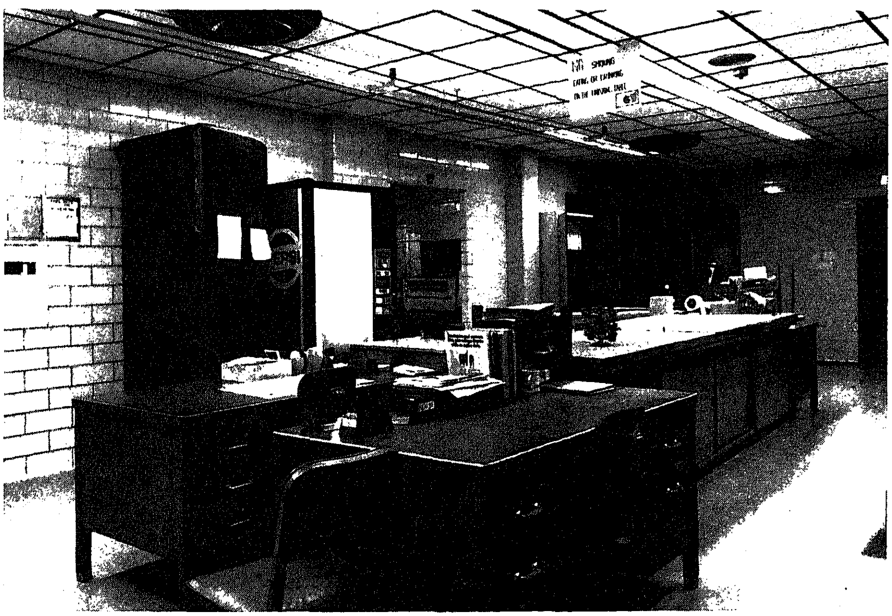
A drying room should be painted with smooth glossy paint, and the floor should be of a material which is easy to clean.

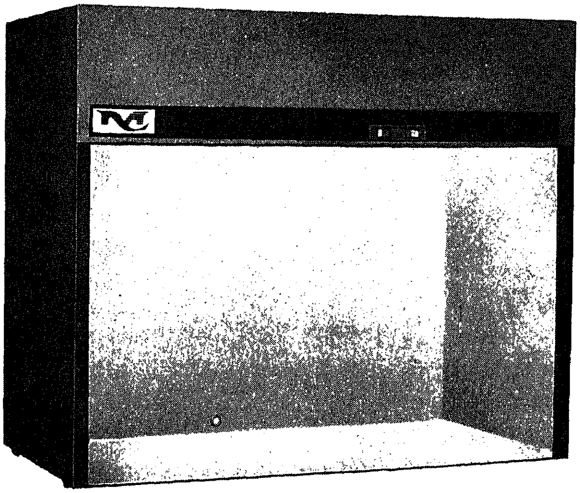
A seldom used darkroom can serve as a drying room for prints but should not be used to dry film because of the possible presence of chemical dust.

Most film is dried either in film drying cabinets which will probably be located either in the film processing room or in the finishing room, or in the case of machine processing, they are dried in the dryer section of the machine. Prints come out of automatic (machine) processors dry or they are dried on continuous belt dryers.

Finishing Room

A finishing room should be centrally located. It is most convenient to have all the various darkrooms adjacent to the finishing room. The





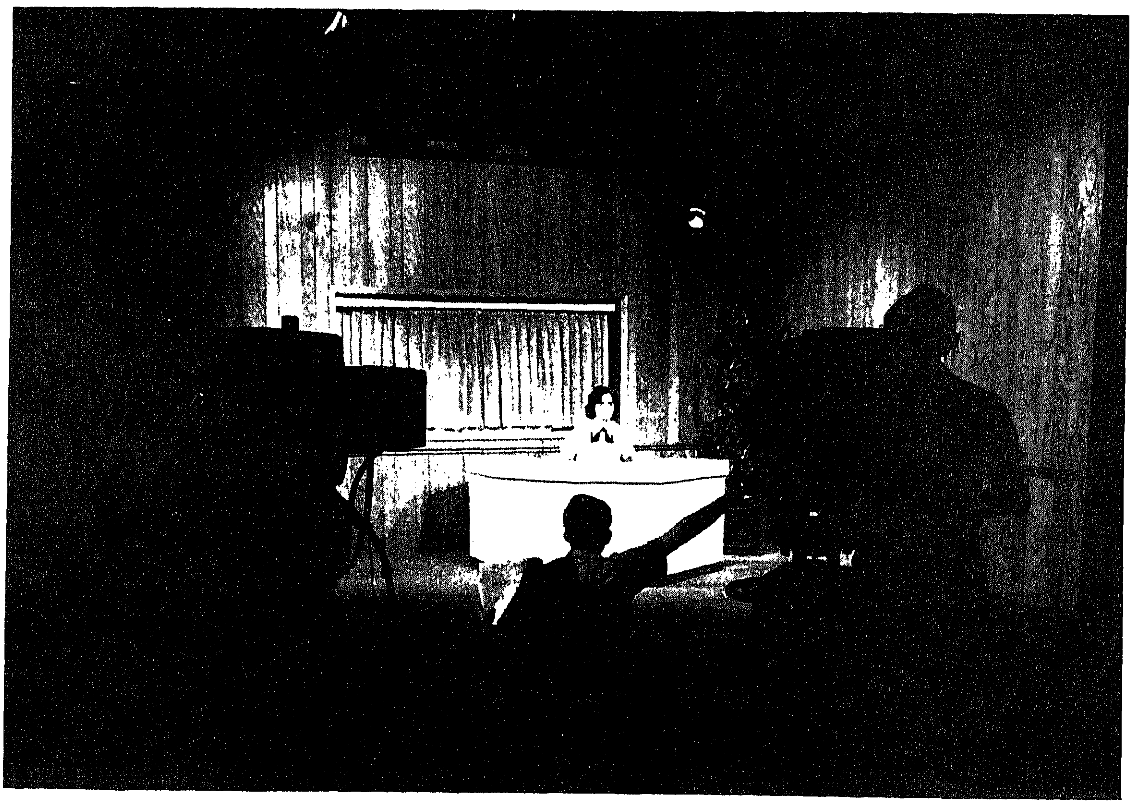
Courtesy Macbeth

Color print viewing booth.

room should be quite large with lots of counter space and a large (standup) finishing table in the center of the room.

Some of the equipment you will find in a finishing room may include film drying cabinets, print washers and dryers, a sink, a dry mounting press, paper cutters, light tables, and other photo finishing equipment and supplies. The finishing room is the hub of photo lab activity and as such it should be well laid out for efficient workflow.

A space in the finishing room should be set aside for viewing prints to examine them for proper contrast, density, color balance, and overall quality. Color prints should be examined under illumination of at least 75 footcandles, and the color temperature of the light should be about 3800 to 5000°K. A special color print viewing station is often provided.



PHAN Czachowski

Copy and Product Studio

Most Navy photographic activities do copy work. Where this work is only occasional, the portrait studio will usually serve well. However, when copy is a large part of the lab's workload, it is better to have a copy studio. This way one or more permanent setups can be left undisturbed between assignments. This saves much time in preparing camera and light setups, and portrait customers are not inconvenienced.

The studio for shooting product photography is often combined with the copy studio and/or the portrait studio.

Portrait Studio

Portrait studios are discussed in Chapter 4, Module 2 of this rate training series.

Motion Picture and TV Studio

The average motion picture/TV studio is usually about 30 feet by 50 feet. It is equipped with two or three cameras mounted on wheeled supports capable of quick repositioning in any direction. Adjacent to the studio will be the TV control rooms, such as the video control and audio control rooms.

The studio area should have space allotted outside the studio itself for storage and production needs. These include set building and painting, furniture and prop storage, storage of sets, etc.

Chemical Mixing Room

In a small photo lab, especially aboard ship, enough chemicals for a day's work can be mixed in a convenient sink. In larger labs and where large quantities of color and black and white processing and printing are carried out, a separate chemical mixing area or room is always better. The size of the chemical mixing room will be determined by the amount of chemicals to be mixed, the requirement for storage of mixed chemicals, and the space available. No matter what size the space is, it MUST BE WELL VENTILATED.

When the chemical mixing room is located on a level above the processing areas, chemicals can be fed to the various processes by gravity. When the space is on the same floor as the darkrooms, the chemicals will have to be pumped or carried to the various processes.

PH3 F. Maldonado

Chemical mixing and storage area.

The chemical mixing room or area should be isolated from areas where chemical dust would be harmful. The walls should be glazed tile, and the floor, ideally, should be made of ceramic tile. Quarry tile is best, and it should have a nonslip surface. Personnel protection facilities such as a deluge shower and eye bath must be provided in this room in case chemicals are splashed or spilled on the person mixing or handling them. And, of course, because of the inhalation of chemical fumes, absolutely NO SMOKING.

Storage Areas

When space allows, there should be three general storage areas—one for chemicals, one for sensitized materials, and one for items such as cameras and accessories, production support equipment, and office and cleaning supplies. If separate areas are not available, then the one storeroom can be separated into various sections simply by the manner in which shelves, equipment, and supplies are arranged.

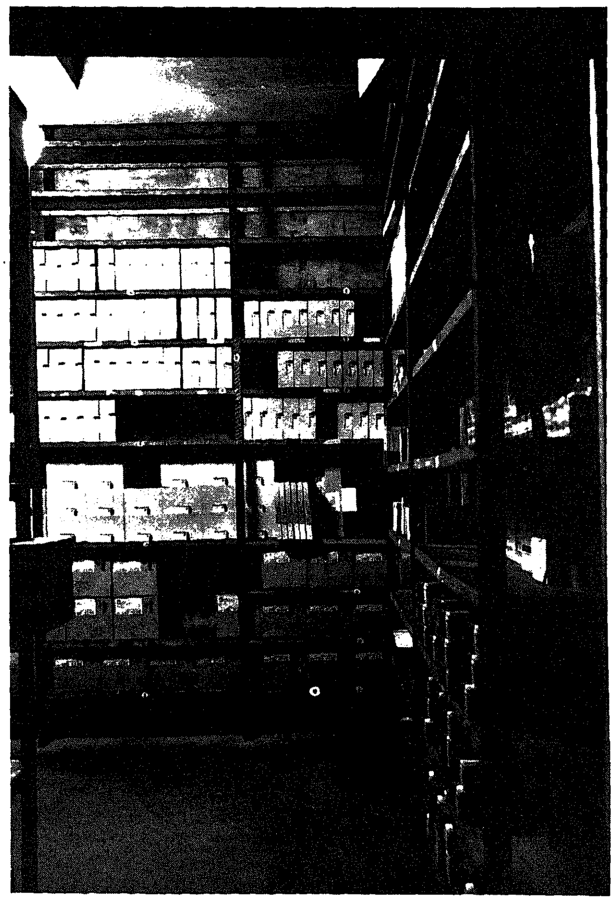
CHEMICAL STORAGE.—Chemicals should be stored in a cool, dry place. They must be stored carefully both before and after mixing. The containers used for shipment of chemicals make excellent containers for chemical storage. However, when they have been unpacked and checked into the storeroom, they should be arranged so that as little damage as possible occurs if any container is accidentally broken. Metal shelves or bins fixed to the walls provide a good place for storing chemicals. Shelves also prevent stacking too many heavy packages on top of one another, which can result in the lower containers being crushed and their contents spilled. This is especially prevalent with certain liquid chemicals sold in soft plastic containers. These boxed containers should not be stacked so as to cause undue pressure on the plastic which could split and spill out the contents. All liquids should be stored on the bottom shelves, then if a container breaks, its contents will damage only the bottom shelf and the floor.

Packages or bags of dry chemicals should not be stored in direct contact with the floor. Some floors, especially concrete, on or below grade, may be damp, and there is always the possibility of water damage due to overflowing sinks or other accidents. If dry chemicals must be stored at floor level, place them on wooden pallets about 4 inches high.

Chemicals that react violently with each other should be stored separately to prevent explosion or fire if the containers should become broken.

Large bottles, large cans, and large packages should be stored on lower shelves because of the greater ease in handling. Corrosive acids should be stored in thick-walled glass containers, which in turn should be protected by wooden or plastic frames or boxes. If the container is a 5-gallon capacity or larger, the protective frames should be supported by a sturdy wooden or metal frame, pivoted or hinged for ease in pouring.

All chemical containers aboard ship, especially those made of glass, must be stowed so they will not slide or crash together when the ship is underway. Rubber matting placed on the shelves helps prevent containers from sliding. Sheets of corrugated cardboard between glass bottles keep them from clashing if they work loose from their lashings. All materials should be tied into small



Film and paper storage.

lots, and the various lots lashed to the shelves or brackets. When tied in small lots, the damage resulting from a broken lashing is much less than if the contents of an entire shelf should break loose at once. Lashings should be inspected frequently.

FILM AND PAPER STORAGE.—Photographic film and paper are perishable and deteriorate with age. Poor storage conditions cause deterioration in both physical and photographic properties of sensitized materials. Sensitized photographic materials must be protected primarily from the harmful effects of heat and moisture, as well as from harmful gases, X-rays and radioactive materials, and physical damage. Adverse storage conditions may cause changes in the color and tone reproduction and speed of films and papers. Color materials are more seriously affected than black and white, especially from the effects of heat and moisture.

Large photographic facilities usually have large walk-in type cold storage rooms where the humidity and temperature are automatically controlled. They will also have a freezer for the long-term storage of color film and paper, infrared film, high-speed black and white film, and process control strips. Smaller labs may have refrigerators and a small freezer.

Refrigeration at temperatures between 40° and 50°F, along with relative humidities between 40 and 50 percent, provide ideal film and paper storage if the materials are to be used within 1 year or so. Changes in the photographic properties of films and papers can be almost completely arrested over long periods by storage in a freezer at temperatures below 0°F.

EQUIPMENT AND SUPPLIES' STORAGE.—The storeroom is generally used for the storage of most photographic equipment in a ready for issue (RFI) condition and for the storage and issue of photographic support supplies, office supplies, and cleaning gear. Heavy and large pieces of equipment should be stored on bottom shelves while frequently issued items are stored near the front of the storeroom or where they can be gotten to quickly.

Other Spaces

some of the other spaces common to many photo labs are reception areas, offices, and file

PH3 Maldonado

rooms for the storage of filed negatives and production records. The file room is also a good place for the safe used for the security of classified photographs, equipment, and information. There should also be two bunkrooms—one for male members of the duty section and one for females—a head with a shower for the duty section, a camera repair shop, a film viewing and editing room, a lounge for the crew, and a utility or deep sink room for swabs and other cleaning tools.

> In a photographic laboratory, it is important that everything be kept shipshape. Among other things this means sweeping down regularly, emptying trash cans when they become filled, holding *weekly* field days, and ensuring that all equipment and gear are stowed in the proper place. Field days should not be scheduled on Mondays or Fridays. All too often Mondays and Fridays are holidays. Instead, schedule field day for a day in the middle of the week, and DO NOT close the lab for field day. Remember your purpose for being—to provide a photographic service.
>
> Ensure that the processing, printing, finishing, and all other spaces are kept clean and orderly. Cleanliness in the photographic spaces cannot be overemphasized, as dust, dirt, chemical contamination, etc., are definite obstacles to top quality photographic production.
>
> Shipshape also means that personnel are kept gainfully employed, that work is accomplished systematically, and that the entire photographic laboratory is run smoothly and efficiently. The daily work routine should call for a *maximum* of work with a *minimum* of effort and confusion. The hallmark of a well-organized photographic laboratory is that everybody knows what to do and when to do it without being told.
>
> A photographic laboratory is a place of business, and, like all businesses, photography should be conducted in an efficient and businesslike manner.

PHOTO LAB SAFETY

Every Navy photo lab must be a safe, healthy place in which to work. The personal safety of the crew and their protection is good leadership as well as good human relations. Every Navy photographer should be familiar with the contents of *Safety Precautions for Forces Afloat,* OPNAVINST 5100.19, and *Shore Activities,* NAVMAT P-5100, especially those sections dealing with photographic operations. Photographic managers should also find out their obligations under the Occupational Safety and Health Act of 1970 (OSHA).

Darkrooms can pose a particular safety problem to workers. Much of their time will be spent under subdued light or in total darkness. Sharp corners on workbenches should be eliminated, cabinets should have sliding doors, recesses for trash cans should be provided, unobstructed safety exits which open outward, and locks which can be forced open from the outside in an emergency are always good ideas.

Accidents which occur in photographic laboratories are usually caused by carelessness or disregard of established, well-known safety rules. All dangerous equipment and materials should be handled with the caution and care their hazardous qualities require.

Safety is a command function and a responsibility of supervisory personnel who must see that safety precautions are rigidly adhered to in areas under their supervision. Each individual working in a photo laboratory is required to observe all safety precautions concerned with methods or techniques pertaining to his work and to report any hazardous situation, equipment, or material which needs attention. Each person working in a photographic laboratory is responsible for warning any other individual whom he believes to be endangered by apparent hazards or by failure to observe safety precautions. It is also the responsibility of each individual to observe all safety precautions and to protect himself by wearing or using safety equipment.

General Safety Precautions

The following safety rules must be followed by personnel working in Navy photo lab areas:

- Slow down when entering or leaving a dark space to eliminate the possibility of collision with

full of solution.

● Operate a paper or print trimmer with extreme care, and always leave the blade down after each use. Stencil or otherwise mark the face of all trimmers with the following warning: "LEAVE BLADE DOWN."

● Do not lean on the glass of retouching tables, printers, or viewing tables, and avoid scoring their surfaces with a sharp cutting blade—under pressure, the glass could break and inflict serious cuts.

● Maintain scrupulous housekeeping practices in all areas where chemicals are handled.

● Make acid-type hand cleaners, such as pHisoderm, available in all areas where dangerous chemicals are handled—in chemical mixing rooms, processing rooms, and other applicable lab areas.

● Wash hands thoroughly with an acid-type hand cleaner and rinse thoroughly with water immediately after handling poisonous chemicals, within minutes after possible exposure to their dust or fumes, and also several times a day when handling or using poisonous chemicals, even though no known contact has occurred. Always wash your hands before going to chow or taking a smoke break.

● Wash rubber gloves thoroughly and promptly with acid-type hand cleaner and rinse well with water after each use, before removing the gloves from your hands.

● Scrub facepieces frequently with acid-type hand cleaners, and rinse thoroughly with water.

● Clean dust respirators thoroughly and frequently.

● Launder work clothing frequently.

● Provide adequate ventilation for processing rooms.

● Impress all maintenance personnel with the importance of avoiding skin contact with chemicals or chemically contaminated surfaces.

spaces. Separate storage areas should be maintained for chemicals which react violently with each other, to diminish the danger of fire or explosion.

● Store corrosive chemicals on shelves strong enough to support their loads of containers and contents. These shelves should have copings or ledges to prevent chemical containers and equipment from extending over the edges or from being shoved off the shelves.

● Keep all corrosive chemicals in thick-walled glass or plastic containers protected by wooden frames or boxes. If the capacity of the container is 5 gallons or more, support the frame by a sturdy wooden, metal, or plastic cradle, pivoted or hinged for ease in pouring.

● Never smoke where volatile solvents are stored or used.

● Have available deluge showers and eye baths.

A great amount of photographic equipment is electrically operated. When you work with or around such equipment, be alert to avoid any possible accident. Inspect all electrical connections and wiring regularly for damaged, frayed, or broken insulation, and for possible short circuits.

Turn off all electrically operated equipment after it has been used. Some equipment—such as dry mounting presses—remain hot for some time after use. As soon as the heating elements in a press have been turned ON, place a plainly visible sign marked "DANGER—HOT" on the equipment, and leave it there until the machine has been turned OFF and is cool.

The following warning should be emphasized to all personnel.

WARNING

Never touch a plug, switch, or any part of an electrically operated machine with wet hands, or while standing in water or on a wet deck. Be sure that your hands are dry before touching such equipment. If the equipment should become wet or be in contact with water while in use, disconnect the current before you attempt to salvage the equipment.

comfort as well as for processing and handling photographic materials.

The photographic process generates chemical odors and fumes, high humidity from processing solutions and wash water, and heat from lamps, motors, dryers, dry mounting presses, and high temperature processing machines. This makes it necessary to introduce a plentiful supply of clean, fresh air into all processing rooms, the finishing room, and studios. Adequate air conditioning and ventilation as well as temperature control are essential to the production of high quality photographs.

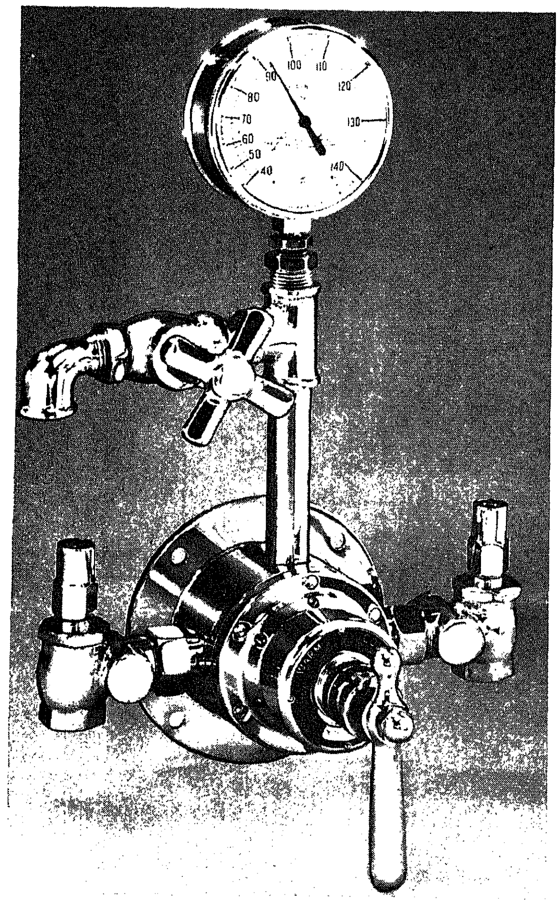
The volume of incoming air should be sufficient to completely change the air in processing rooms in about 8 to 10 minutes. The air should be diffused or distributed so that drafts are not created.

Air exhaust systems or outlets should be located to remove humid or heated air and

An exhaust hood over a film processing sink.

Some photographic operations and processes require local exhaustion by an extraction hood. These usually include chemical mixing, continuous processing machines, and certain steps in some color processes. An extraction or ventilation hood should be located as close as possible to the source of contamination.

The temperature in a photographic laboratory should be maintained at about 75 °F with a relative humidity of about 45 to 50 percent. This temperature and humidity level is generally compatible with photographic production while providing comfortable working conditions for most sailors.



Eastman Kodak Co.

Water temperature control valve.

WATER SUPPLY

A plentiful supply of clean water is essential to any photographic process. Purity of the water supply is not as critical as might be expected. If the water is suitable for drinking and tastes reasonably good, and is free of iron, it will most likely be satisfactory for photographic processes. Water requirements are divided into three categories:

- For processing film and prints
- For machine washing of film and prints
- For machine processing

A continuous flow of water, in the amount and psi specified by the manufacturer, should be provided for the specific equipments installed in each area. Thermostatic temperature regulating or mixing valves should be installed in the water supply lines at each chemical mixing, processing, and washing station in order to maintain, at the fixture outlet, a water temperature to within ± 1/2 degree.

All water for film processing should be filtered to remove particles larger than 5 microns.

When water is heated, air bubbles come out of solution, giving the water a milky appearance. This occurs most often when the incoming cold water is below about 50°F. These bubbles can adhere to film or paper and interfere with processing and washing. To eliminate the problem, the incoming water can be aerated. Aeration causes the small bubbles to combine with larger ones that disperse easily. For hand processing sinks (sinklines), an aerator, which is nothing more than a fine mesh screen, is put in the taps. An aerator of this type can be purchased at any hardware store. For machine processing, a ballast tank is used to remove the small bubbles. A ballast tank is an open tank of suitable size in which cold and hot water are mixed. Air is passed through the tank as large bubbles which pick up the finer bubbles and then disperse at the water surface.

Photo labs should have both hot and cold water lines with a water pressure of not less than 45 psi. For small scale hand processing, lower pressures will only be an inconvenience. However, most machine processes require at least 45 psi.

Water Conservation

With today's ever-increasing cost for resources, including water, it is more important than ever for us to conserve water, especially aboard ship where every drop of fresh water may have to be distilled from seawater. There are many ways we can conserve water in our photo labs, thus saving dollars for much needed weapons or even higher pay.

Some of the steps you can take are:

- Install efficient washers; the water in a washer should change completely every 5 minutes.
- Do not use washers that are too large for the size of prints or amount of prints to be washed.
- Insulate all long hot water lines. This helps to save water by making hot water available immediately when the tap is turned on. At the same time, it saves money on the fuel used to heat the water.
- Use a product such as Kodak Hypo Clearing Agent; this preparation can save two-thirds or more of the water normally used to wash negatives and prints.
- Reduce unnecessary water depth in washing tanks or trays. A greater rate of flow is necessary in deep tanks to achieve satisfactory washing in the minimum time.
- Use an automatic tray siphon or a similar tray bailer if you wash sheet materials in a tray, because water running into a tray from a tap or hose pipe does not usually make an efficient washer.
- Use water conservation devices for automatic processors. When a machine is standing by, conservation fittings automatically reduce the flow of water through the machine to that necessary to maintain solution temperatures only.
- Wash prints, where possible, in three stages by arrarnging three washers in series—each one at a lower level than its predecessor. In this way, fresh water from the upper tank flows into the two lower tanks. Move prints at regular intervals from the lowest tank—where the bulk of hypo is

removed—to the intermediate tank and then to the upper tank, where washing is completed by the incoming fresh water. Incidentally, use a ringing clock to time the intervals; you will eliminate guesswork and avoid too long a washing time and the consequent waste of water.

● Use seawater to wash films and prints, when it is available and fresh water is scarce. Saltwater is very efficient in removing hypo from photographic material. However, residual sodium chloride (salt) causes fading of the silver image, especially when it is combined with residual hypo. Therefore, if seawater is used for washing, give a final wash of 5 minutes—or four complete changes—in fresh water.

● Use resin-coated (RC) papers which require less wash time.

If you are ever involved in the design or rehabilitation of a photographic or audio-visual facility, Eastman Kodak Company, through their Technical Sales Representatives, can make an on-site assessment of your needs. They can also provide professional planning help through their Facilities Design Section of the Professional and Finishing Markets Division.

CHAPTER 2

CHEMICAL MIXING

Photography is essentially a chemical process and you depend upon the chemical process to produce visible and permanent images. An important requirement for optimum photographic processing is the careful and correct preparation of photographic solutions. Improper mixing of chemicals or contamination during mixing can have far-reaching effects on operations, quality, production, and mission accomplishment in our Navy photo labs. It is often difficult to determine the cause of poor quality when improper chemical mixing is at fault, and the necessity for discarding incorrectly prepared or contaminated solutions cuts down on production and is a waste of taxpayers' money—yours and mine.

The main function of the darkroom portion of the photographic process is to develop film and produce prints, and this requires photographic chemistry. It may be your job to ensure that all chemicals needed are mixed and checked for quality. *This is a responsibility that you cannot take lightly.* An improperly mixed developing solution may cause an entire mission to be lost. It is essential that you employ the utmost care when mixing, checking, or analyzing the photographic solutions used in your laboratory.

PHOTOGRAPHIC CHEMICAL AND SOLUTION STORAGE

When you receive chemicals in the photo lab, the cartons, packages, or containers should be dated to show either the date received or the date shipped. This helps provide proper stock rotation and systematic control of chemical usage. Chemicals should be issued from the storeroom on a first-in-first-out (FIFO) basis.

Unmixed chemicals should be stored in their original, unopened containers in a cool, dry, well-ventilated storage area where the temperature is maintained at about 75 °F with a relative humidity of about 40 percent.

Prepared solutions, like dry chemicals, must also be protected from adverse conditions, especially oxidation and contamination. When the following recommendations are adhered to, most *unused* solutions stay in good condition for reasonable periods of time.

- Small amounts of replenisher and stock solutions are best kept in stoppered or screw cap bottles. Glass bottles are best for developer and developer replenisher. Screw caps must be free of corrosion, foreign particles, cardboard inserts, and they MUST be airtight. Never interchange bottle tops from one bottle to another. A cap-to-bottle color or number code is suggested.

- When large bottles are used to store solutions the air space in the bottle is increased each time solution is removed. Since this increases the chance for oxidation, store solutions in small bottles instead. The entire contents of a small bottle can then be used at one time. However, a small air space should be left even in small bottles. This allows for varying solution volume due to temperature changes and keeps the cap from loosening or the bottle from bursting.

- When tanks are used for the storage of large volumes of solutions, they should have floating lids to protect the solutions from aerial oxidation. Dust covers should also be used to cover the top of the tank. A lid or dust cover to tank code is suggested here also.

- Always follow the manufacturer's storage and capacity recommendations that are packaged with the chemicals. Do not use chemicals that have been in storage too long.

- Before you use any solution, no matter how long it has been mixed or in storage, check for discoloration. Each solution has its own "signature" or characteristic appearance; and any

are any, carefully stir the solution to redissolve them. If you have any doubt about the quality of the solution, it should be discarded.

- Store all solutions at about 75 °F.

Most photo processing chemical formulations are based on both their photographic qualities and their chemical stability or keeping qualities, both on the shelf prior to mixing and as prepared solutions. After long-term storage some chemicals may lose some chemical activity.

MIXING, TESTING, AND STORAGE EQUIPMENT

The type of material used for photographic chemical mixing, solution testing, and storage as well as film-handling equipment, must be considered from a standpoint of its effect on the solutions. Materials commonly used in the construction of this equipment are type 316 stainless steel, polyethylene, and glass. Related equipment such as solution transfer lines, mixer shafts, impellers, and machine parts are also made of these same materials.

Some metals are not suitable for use with photo solutions. Serious chemical fog and developer changes can be caused by tin, copper, brass, and bronze. Aluminum, lead, nickel, zinc, galvanized iron, and Monel, when used with developers and fixers can be harmful to films and papers. When these metals are used, silver theosulfate from the used fixer may adhere to them. Even if the implements are washed after being in the fixer, enough silver theosulfate can be transferred to the developer in the next processing or mixing run to cause stain, fog, or image tone changes to subsequently processed materials.

Wooden paddles and other absorbent materials must not be used with photographic solutions. Once they have been used it is almost impossible to wash them clean of absorbed chemicals.

MIXING CONTAINERS

Chemicals should always be mixed in cylindrical containers made of suitable materials.

vessel which uses mechanical agitation becaus large amounts of air may be introduced an splashing may occur. In other words, the mixin container, and for that matter, scales an graduates, should be sized to the quantities an volumes of solutions required.

SCALES

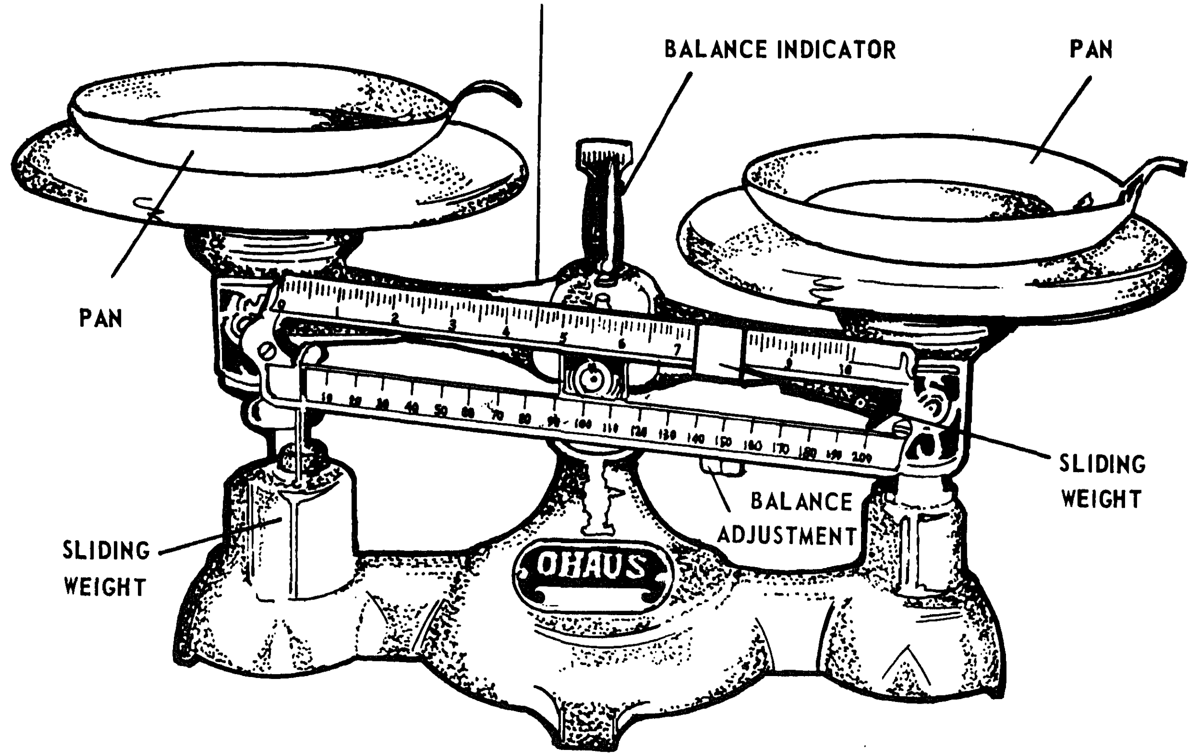
The size of the scales used for weighin chemicals should be in proportion to the quantit of the chemical being weighed. When chemical are weighed on a scale, the pans which hold th chemicals should be protected by covering then with clean sheets of paper. Regular writing pape or typing paper can be used. Balance both larg and small scales, and weigh the chemicals wit the cover papers in place. Use a clean piece o paper of the same size and weight for eac chemical to be weighed. This procedure help eliminate possible chemical contamination durin weighing and keeps chemical dust off the pans o the scales.

When you choose a scale for chemica weighing, always apply the rule that the smalle the quantity to be weighed, the greater th accuracy of the scale must be. Small quantitie of chemicals—500 grams or less (or 1 pound o less)—are best weighed on a scale that is accurat to 0.1 gram (or 1 grain). Weigh large quantitie on larger capacity scales having a proportionat degree of accuracy.

The heart of the beam balance of a scale i the bearing surface that supports the beam Friction at this point must be held to an absolut minimum in order to give accurate measurement This bearing arrangement is critical and delicat and will not stand any abuse. You must give th scales the same care that is given to any extremel delicate precision instrument.

When you want to weigh a specified amoun of chemical to fulfill the needs of a formula operate the scales in the following manner:

1. Set the sliding weights so that they indicat the correct weight as specified in the formula. I you are using a scale with separate weights, plac them in the right-hand pan. Doublecheck you settings.



Chemical weighing scales.

2. Add the chemical slowly to the pan on the left. Make it standard practice to use paper on the balance pans. Use an equal size sheet of paper on both pans so that the overall trim of the beam is not altered appreciably. If an imbalance occurs, the balance adjustment can be used to compensate for it.

3. Add the chemical until the balance indicator shows that the weight of the chemical is the same as the scale weights. (If the chemical is in a large container, use a scoop, ladle, or spoon to transfer the chemical to the scale, in order to prevent excess chemical from spilling onto the pan.)

4. Remove the weighed chemical from the left pan by picking up the paper or pan and then slowly pour the contents into the solution you are mixing. After adding the chemical to the solution, carefully discard the paper in such a manner that none of the finely powdered chemicals become airborne.

5. Put a fresh sheet of paper on the left pan before weighing the next chemical. Be sure to retrim the balance each time you change the paper to avoid an error in weighing the next chemical.

If you have a quantity of chemical and wish to find out its weight, use the following procedure.

1. Place the chemical to be weighed on a fresh paper on the left pan, making sure that the balance has been trimmed for the fresh sheet of paper.
2. Starting with the sliding weights on their "0" settings, slowly move the weight until the balance indicator shows a state of balance. If you are using a scale that uses separate weights, add the weights to the right-hand pan.
3. Determine the weight of the chemical by adding up all of the weights that have been placed to the right end of the beam (i.e., by adding the values of the sliding weights and any separate weights in the right-hand pan).

Regardless of the type of scale you use in weighing your chemicals, there are certain things you should always observe:

- Avoid handling the small weights with your fingers, since perspiration and oil on your hands could change the true weight of the smaller weights and cause inaccurate measurements.

- Handle all small weights with a pair of tweezers.

- Always weigh the chemicals in the order that they are given in the solution formula.

- Scales should be thoroughly cleaned after each use and returned to their proper place.

GRADUATES

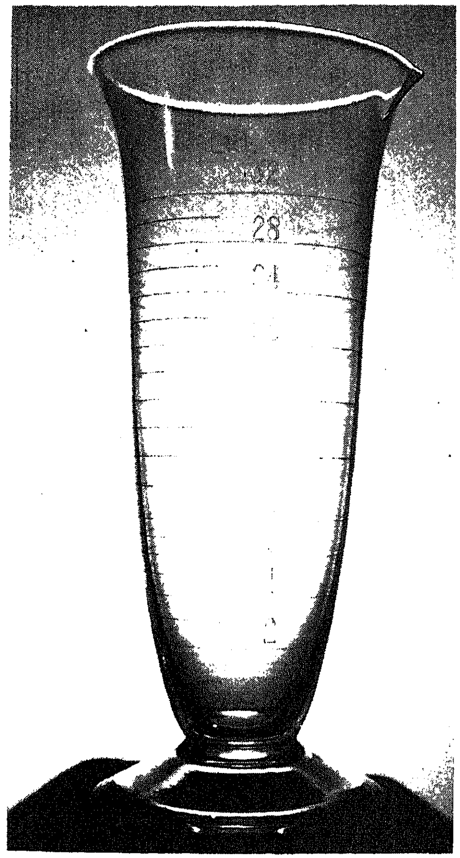
Scales are used for measuring dry chemicals. On the other hand you will use graduates to measure liquids.

Graduates are made in varying sizes, calibrations, and of various materials. Although most of the graduates you use are calibrated in the U.S. liquid measurement system of drams, ounces, quarts, and gallons, it is not uncommon to find them also calibrated in the metric liquid measurement system of liters.

Glass is most commonly used for making graduates because it is inert to most chemicals, transparent, and reasonably durable. Graduates are also made from plastic and stainless steel. When using graduates made of plastic, be sure that you do not try to measure strong acids, such as sulfuric acid, which could cause severe damage. You should also make sure that the material the graduate is made of does not react with any of your photographic chemicals.

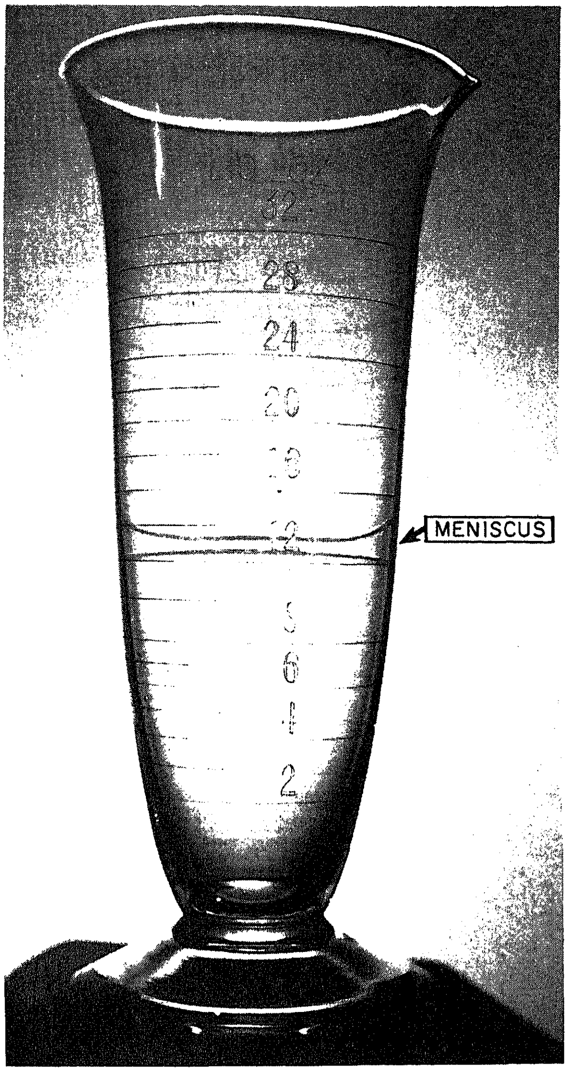
For accuracy in measuring liquids, graduates which are proportional in size to the quantity of solution being measured should be used; i.e., an 8-ounce graduate should be used instead of a 32-ounce graduate to measure 2 or 3 ounces.

A glass graduate should be held at eye level; pour the solution into it until the surface of the liquid reaches the correct mark. The correct amount will be indicated by the lower of two



Glass graduate.

through the side of a glass graduate if it is held correctly. With an opaque graduate, such as stainless steel, the two lines can be seen by looking down into the graduate from an angle. Stop pouring the solution when the *lower line* of the liquid reaches the calibration mark indicating the desired amount. Major divisions are indicated by numbers on the graduate. Subdivisions are shown by calibration lines only. You must compute the value of the individual subdivisions. For example, the marked or numbered lines may indicate ounces and read in series of 10. If there is only one

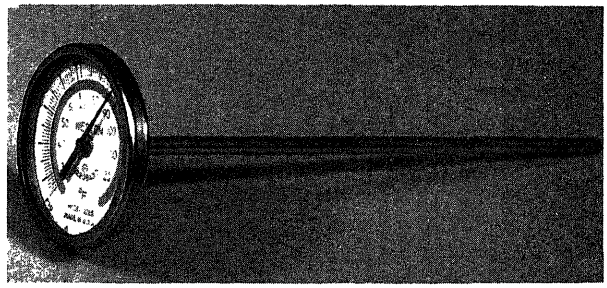


Accurate measure with a graduate is indicated by the lower line of the meniscus.

THERMOMETERS

All chemical actions take place faster at high temperatures than at low temperatures. In the photographic process, when you mix or use a solution, it is essential to know its temperature.

Thermometers are used to measure the temperature of the solution and may be made of glass or metal. The average glass thermometer consists of a bulb, containing either mercury or colored alcohol, attached to a capillary tube. This tube may be calibrated or it may be secured to



Dial-type thermometer.

a graduated scale. When reading a thermometer, your eyes should be level with the top of the liquid column in the capillary tube, otherwise the reading may be off as much as 2 or 3 degrees. This error is due to the refraction of the cylindrical magnifier which is built into the capillary tube.

Most Navy photographic laboratories have metal dial-type thermometers, which are made of corrosion resistant steel. They have a long thin metal stem or rod with a circular dial indicator at the top. The action of this thermometer is remarkably fast and the dial is easy to read.

The accuracy of all laboratory thermometers should be checked regularly against one of known accuracy.

HYDROMETERS

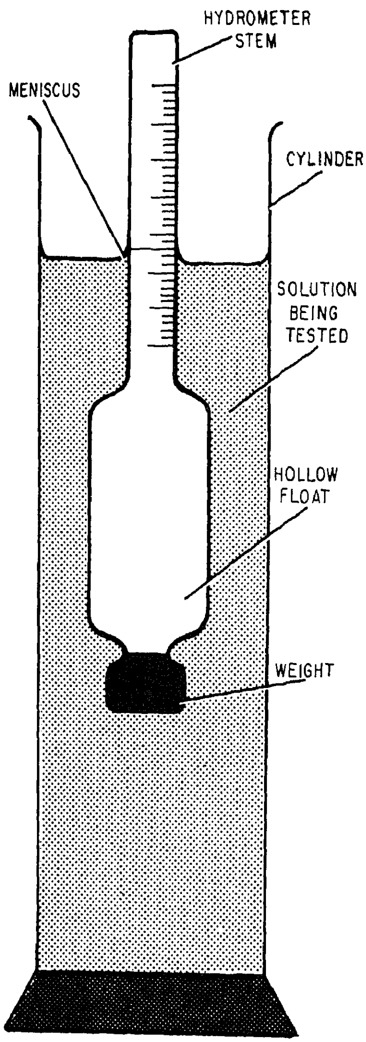
Another measuring device used in photography is the hydrometer. A hydrometer is used to determine the specific gravity of a solution. A specific gravity check is one of the first tests to verify the strength of a solution. If the same chemicals are used and if the same quantity of chemicals and an equal volume of water are used each time, the resulting liquid will have approximately the same specific gravity each time. This is a characteristic of that particular solution, provided that all specific gravity measurements are made at the same temperature.

The specific gravity should stay within an upper and a lower limit determined for each solution. Variations beyond the upper limit—indicating a denser or heavier liquid—suggest that more than the prescribed amount of one or more of the ingredients has been used, an ingredient foreign to the solution has been added, or the chemicals were not diluted properly. Differences in the opposite direction—measurements that fall

below standard limits—might indicate that something has been left out, a foreign chemical has been substituted, or that more than the correct amount of water was added.

The silver content of a fixing bath increases as the bath becomes exhausted. This causes the specific gravity of the solution to rise. Hence, in addition to testing the consistency of chemical solutions, specific gravity tests may be used to check the amount of silver in the fixing bath. A hydrometer used for this purpose must be calibrated in grams of silver per liter of solution.

A hydrometer consists of a hollow tube with an enlarged lower section, or float, topped by a narrow stem. The lower section is weighted so that



Hydrometer.

the hydrometer will float in liquids with its stem protruding from the surface. The stem is graduated with marks which are used to indicate the density of the liquid in which the hydrometer floats. When the density of the liquid is high, it supports the hydrometer more easily, so that less of the stem is submerged. Less dense liquids allow the hydrometer to sink deeper.

Hydrometers are commonly graduated in terms of specific gravity, which is the ratio of the density of a substance to the density of water. However, they may be designed for special purposes, with resulting differences in the graduated scale. An example is the hydrometer mentioned previously, which is used to check the silver content of a fixing bath.

Hydrometers used in photographic laboratories are normally supplied with a glass cylinder which serves as a container for the solution being tested.

Due to the effects of surface tension and capillary action, a meniscus is formed at the interface between the solution and the hydrometer stem. The reading is taken at the point where the *top* of the meniscus intersects the stem of the hydrometer.

Specific Gravity Testing

To test the specific gravity of a solution, proceed as follows:

1. Fill the hydrometer cylinder with the sample to be measured.
2. Adjust the temperature of the sample to the temperature specified for the hydrometer.
3. Ensure that the hydrometer is thoroughly dry. Then carefully lower it into the sample.
4. Read the hydrometer at the *top* of the meniscus as seen along the side of the hydrometer stem.
5. Compare the readings with the prescribed standard. Deviations beyond limits call for a new sample and another reading. If the second reading is also outside the limits, the validity of the solution is questionable and should be carefully correlated with the results of other tests. Personnel concerned with mixing developers and fixers must be on the lookout for any specific gravity reading that varies from normal.

As mentioned earlier, a check on specific gravity is usually the first test to be made. Oftentimes, when a specific gravity reading is off,

a check can be made and the cause found; e.g., if a certain chemical were omitted. Sometimes this chemical can be added to the solution, saving the expense and time of remixing.

pH METERS

The acid or alkali state of a solution is measured in pH values. The pH value of developers and fixers influences their activity and proper strength. pH is basically a measure of the degree of acidity or alkalinity of a processing solution, and as such provides an invaluable aid in determining the degree of accuracy with which the processing solutions have been prepared. Photographic developers usually have a pH of 8 to 12, while fixers range between pH 3.1 and 5.

The following scale indicates the location of acids and alkalis by their pH value (strength).

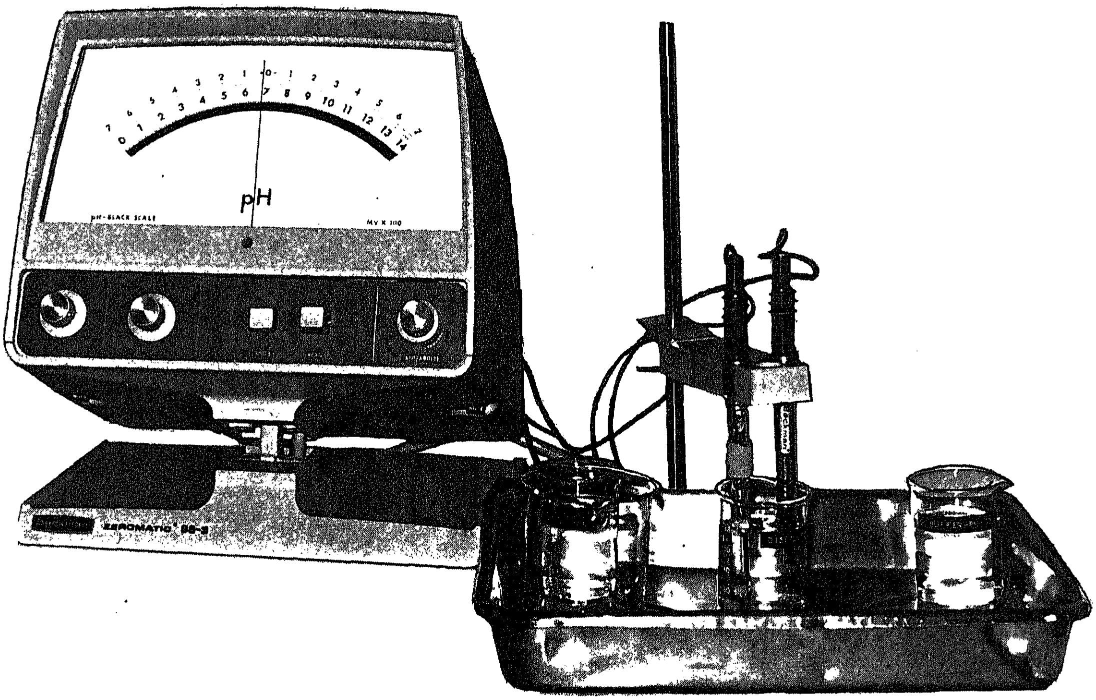
pH VALUES

ACIDS	NEUTRAL	ALKALIS
1 2 3 4 5 6	7	8 9 10 11 12 13 14

With proper equipment the pH can be determined and interpreted. A pH of 7 is neutral. Working down from this point, the figures indicate weak acids with a pH of 6 on to strong acids with a pH of 1. Working up from a pH of 7, the figures indicate weak alkalis with a pH of 8 to strong alkalis with a pH of 14.

The pH values are numbered on a logarithmic scale. From 0 through 6, each number indicates a degree of acidity 1/10 as strong as the preceding number, but 10 times stronger than the next succeeding or higher number. A solution with a pH value of 4, for example, would have a degree of acidity 10 times stronger than a solution with a pH value of 5, but only 1/100 the strength of a solution having a pH value of 2. When determining the degree of alkalinity of a solution figure in an opposite manner. From 8 through 14, each number represents a degree of alkalinity 10 times as strong as the last preceding number, but 1/10 the strength of the next higher number. For example, a solution having a pH value of 11 indicates that the solution has an alkalinity 1000 times stronger than a solution having a pH value of 8, but it would be only 1/100 as alkaline as a solution having a pH value of 13.

Litmus paper can indicate whether a solution is acid, alkaline, or neutral, but it will not indicate



the actual pH value. For this purpose a pH meter should be used.

A pH meter is an amplifier meter, with a scale that reads from 0 to 14, and an electrode apparatus. A pH meter also has a reference electrode and a pH measuring electrode, or these two can be combined into one combination electrode. The pH electrode actually measures the pH while the reference electrode, which contains an electrolyte solution, is used only to complete the electrical circuit. The first step in measuring pH is to establish a point of reference by a standardization procedure. To standardize the pH meter, it is necessary to place the electrodes in a special buffer solution.

Buffer solutions are available at the exact pH values for this precise standardization. Since these solutions resist change in pH value at specific temperatures, their accuracy is dependable. Always select a buffer with a pH value as close as possible to the pH of the sample to be tested. For the most accurate measurements, ensure that both the sample and the buffer solution are at the same temperature.

When measurements of a new sample with a different pH range than the previous measured sample are to be made, it is necessary to standardize the instrument with another buffer which has a pH value nearer the pH of the new sample. In addition, the instrument should be standardized at regular intervals during a long series of measurements, or every few days.

Measuring the pH value of a known buffer solution and adjusting the meter scale establishes a reference point to use in the second measurement. The second measurement consists of reading the pH value of the sample. The pH value of the sample is relative to the pH of the buffer. Summarizing, the basic procedure for operating a pH meter is first to standardize the meter by measuring a buffer solution of a known pH value, and adjusting the meter accordingly, then, measure the pH value of the sample.

The ability of a pH meter to accurately determine the pH value of a solution may be used for the following purposes:

- To verify that chemicals have been properly mixed.
- To test prepared chemicals.
- To assure standardization of the processing solutions.
- To determine the exact replenishment rates for photographic chemical solutions.

Tolerances in pH values must be established for individual laboratories because of such things as differences in procedures, types of equipment, impurities in water, etc. On the average, pH readings of 10 different batches of each solution, mixed at different times, must be taken and recorded to establish these standards. These batches should be mixed as they would be for regular use but under very close control to ensure that the solutions are mixed at the correct temperature, in the proper sequence, etc. This operation helps in determining what the tolerance can be. This tolerance is the amount of variation which can be had in the pH while still producing results of good quality.

While control pH values will indicate the desired pH level of a particular processing solution, it must be understood that all subsequent mixings of a given solution may not yield the same, exact pH value. Thus a tolerance limit must be established.

The foregoing discussion of pH meters is intended as an introduction only. Detailed step by step operating instructions for pH meters are not included in this Chapter. Operating instructions in the form of technical orders and manufacturer's manuals for the pH meters will be available to you in the photographic lab.

MIXERS

In the Navy we use two methods of mixing chemicals—hand mixing and machine mixing. Hand mixing is used when only small quantities of solutions are needed or when machines are not available. Machine mixing is necessary to handle the large production requirements of most Navy photo labs.

Agitation Mixers

Proper agitation of the solution during mixing increases the rate at which the chemicals are dissolved and prevents undesirable side effects. For proper agitation, an agitator-type mixer that will not cause excessive amounts of air to enter into the solution should be used. Developers are

quickly ruined by oxidation; a few minutes of improper and violent agitation can weaken a developer and cause it to underdevelop and sometimes stain film. Too little agitation during mixing may permit the powdered chemicals to settle to the bottom of the mixer and form hard lumps. If these lumps of chemicals go undissolved and undetected they can clog pumps and plumbing during transfer from the mixer to the storage tank, and they can also cause the solution to be less active.

There are several types of agitation mixers available, these include large capacity models for preparing large volumes of solutions and small models for making small amounts of solution.

Impeller Mixers

Impeller mixers provide thorough, rapid mixing, but they *must* be used with care to prevent frothing or foaming and introduction of air into the solution. The solution must be mixed so a minimum amount of air is drawn into it. If the shaft is placed in the center of the container, the impeller causes a whirlpool effect, which introduces excessive amounts of air into the solution. Furthermore, when the shaft is in the center of a container, there is very little agitation about the center of the container's bottom and undissolved chemicals pile up directly beneath the end of the shaft.

Avoid bumping the shaft or impeller on the sides or bottom of the mixing vessel, and never add large lumps of chemicals to a solution, since either of these procedures may bend the mixer shaft. A bent shaft produces excessive vibrations which can ruin the motor bearings.

Courtesy Kreonite, Inc.

Agitation-type chemical mixers.

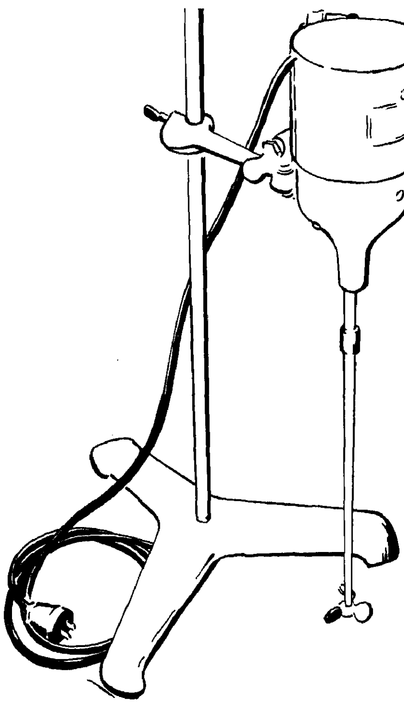
WEIGHTS AND MEASURES

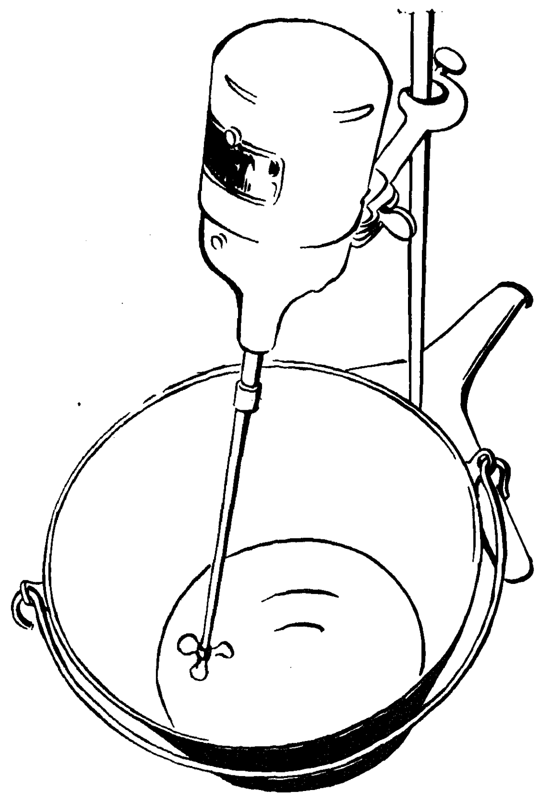
The different systems of weights and measures used in chemical mixing, and the relationship of the various units to one another are complex matters that every photographer who prepares photographic solutions should understand.

Photographic formulas are usually published in two systems of weights and measures, avoirdupois and metric. In the avoirdupois system, chemicals are weighed in grains, ounces, and pounds and dissolved in pints, quarts, or gallons of water. In the metric system, they are weighed in fractions or multiples of grams, and dissolved in cubic centimeters or liters of water. With the aid of a conversion table, a formula given in one system can be easily converted to the other.

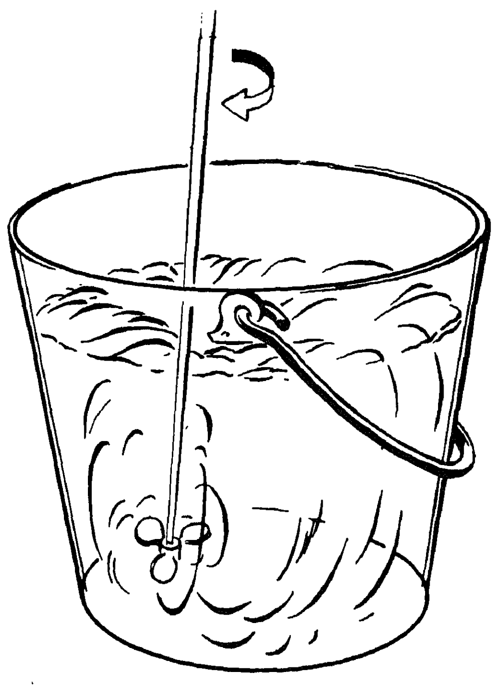
Weight and Volume Conversion

When you know:	You can find:	If you multiply by:
ounces	grams	28.3
pounds	kilograms	0.45
grams	ounces	0.0353
kilograms	pounds	2.2
teaspoons	milliliters	5
tablespoons	milliliters	15
fluid ounces	milliliters	30
cups	liters	0.24
pints	liters	0.47
quarts	liters	0.95
gallons	liters	3.8
milliliters	teaspoons	0.2
milliliters	tablespoons	0.067
milliliters	fluid ounces	0.034
liters	cups	4.2
liters	pints	2.1
liters	quarts	1.06
liters	gallons	0.26





SHAFT AND PROPELLER POSITION
FOR MOST EFFICIENT MIXING



CORRECT BOTTOM-TO-TOP
SOLUTION AGITATION

HOW A SOLUTION SHOULD NOT
BE MIXED

The avoirdupois system is graduated in grains, ounces, and pounds;

27.34 grains	=	1 dram		
16 drams	=	1 ounce	=	437.5 grains
16 ounces	=	1 pound	=	7000 grains

and liquid is graduated in fluid drams, ounces, pints, quarts, and gallons.

8 fluid drams	=	1 fluid ounce		
16 fluid ounces	=	1 pint		
2 pints	=	1 quart	=	32 ounces
4 quarts	=	1 gallon	=	128 ounces

The metric system for weights is graduated in grams and kilograms.

1 milligram	=	1/1000 of a gram		
1 centigram	=	1/100 of a gram		
1 decigram	=	1/10 of a gram		
1 gram	=	the unit of weight		
28.35 grams	=	1 ounce	=	437.5 grains
1 hectogram	=	100 grams		
1 kilogram	=	1000 grams	=	2.204 pounds

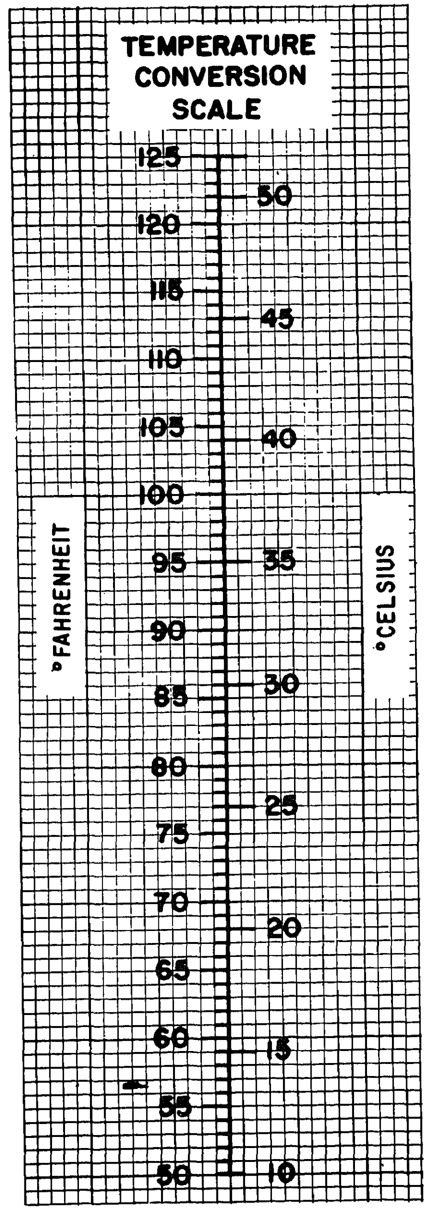
The metric system for measuring liquids is graduated in cubic centimeters and liters.

1 milliliter	=	1 cubic centimeter	=
1 liter	=	1000 cubic centimeters	
	=	33.81 ounces	

Two systems of temperature measurement are used in the lab—Fahrenheit and Celsius. The Fahrenheit scale uses °F as a temperature symbol. The Celsius scale uses °C as its symbol. On the Fahrenheit scale 32 degrees is the freezing point of water and the boiling point is 212 degrees. The difference being 180 degrees. The Celsius scale is 0 to 100 degrees from freezing to boiling. A Fahrenheit degree is smaller than a Celsius degree, one Fahrenheit degree being 5/9 of a Celsius degree. To convert Fahrenheit degrees into Celsius, subtract 32, multiply by 5 and divide by 9; e.g., $(°F - 32) \times 5/9 = °C$. To convert Celsuis to Fahrenheit, multiply by 9, divide by 5, and add 32; e.g., $(°C \times 9/5) + 32 = °F$.

Temperature Conversion

When you know:	You can find:	If you
degrees Fahrenheit	degrees Celsius	subtract 32 then multiply by 5 then divide by 9
degrees Celsius	degrees Fahrenheit	multiply by 9 then divide by 5 then add 32



Temperature conversion scale.

PARTS AND DROPS

Some formulas use the word "parts" as a measure. They may call for two parts of one chemical, one part of another, and any number of parts of water. This is frequently done when two or more stock solutions have to be combined to make the working solution. In such cases the word "parts" means that any convenient *volume* measurement may be used, but that the same measure should be used for everything required by the formula. A part may be a fluid ounce, or a gallon, depending upon the total quantity of working solution needed. Formulas use parts only when volume is to be measured.

> The term *stock solution* identifies a concentrated chemical solution. A *working solution* is the solution used for processing. The working solution may be the same as the stock solution but more likely is a diluted stock solution.

The formulas in some older publications may also call for drops, but drops are an extremely inaccurate means of measurement. The size of a drop of one solution will vary with the temperature and may be a different size from a drop of another solution. A drop of water measured with the average dropper or burette is approximately one-twentieth of a cubic centimeter. Therefore, when small quantities of a chemical (under 10 grains) are given in modern formulas, they are expressed as drams or cubic centimeters (cc) of a percentage solution, which avoids the uncertain quantity of volume by drops. (Percentage solutions will be discussed later in this Chapter.)

CHEMICAL MIXING RULES

For both personal safety and efficiency when mixing processing solutions, there are a few commonsense rules by which you must abide. Mixing chemicals is simple enough, but even a slight error can change the working characteristics of some solutions. The principles of common cleanliness will prevent many chemical troubles, and being precise when weighing and measuring enables you to accurately predict the results of a process. Without cleanliness and accuracy, many processes become guesswork.

Chemicals should not be mixed in areas where sensitized materials are handled or stored. Chemical dust and/or fumes can ruin these materials. There should be adequate ventilation, a complete air change every 3 minutes, and an exhaust fan to the outside atmosphere in the area where chemicals are mixed.

CONTAINERS

Containers for photographic solutions (mixing/use/storage) should be made of a material which will not affect or be affected by the chemicals. Glass is the best material. Stainless steel is a highly suitable material, provided it is of the proper composition. Hard rubber and glazed earthenware may also be used satisfactorily. Acid and alkali-resistant plastic containers are acceptable.

All containers, graduates, scales, sinks, and every utensil used in the photographic laboratory should be clean at all times. As soon as work is finished with any item of equipment, it should be cleaned and returned to its place. If chemicals are spilled, clean them up as soon as possible.

Chemical solutions and chemical dust will corrode and cause pitting of most materials including stainless steel if allowed to remain for any length of time.

ACCURACY

Photographic quality suffers if the chemicals are improperly mixed. You must be certain that the amount of chemical you put into a solution is the amount specified in the formula. Therefore, you must use accurate measuring devices such as scales and graduates.

The mixing of processing solutions has been greatly simplified over the years by the introduction of packaged photo processing chemicals. Packaged chemicals come in convenient sizes for most needs. They offer standardized quality, economy, and convenience. Many photographic solutions may still be compounded by mixing the individual ingredients according to a formula.

Packaged chemicals include film and paper developers and fixing solutions of various types which are manufactured under tightly controlled conditions. These packaged chemicals may be

obtained in either liquid or powder form. Processing solutions can be mixed easier, faster, and more accurately with packaged chemicals than with bulk chemicals.

When mixing packaged chemicals, you should always mix the entire package. Packaged chemicals usually contain more than one ingredient. During shipment and handling these ingredients may separate with the heavier elements settling to the bottom of the package. When only part of the package is mixed, some of the ingredients which have separated or settled may not be put into the solution and the results of the process will not be predictable.

The increased cost of packaged chemicals can be justified by the man-hours saved and accuracy in preparation. Using packaged chemicals may also eliminate the variables caused when you use bulk chemicals manufactured by several different companies, errors made in interpreting formulas, and errors made in ordering and stocking large quantities of chemicals.

MIXING

Always add chemicals to the water or solution. Dry chemicals should be poured slowly into the water while it is being stirred. When preparing a developer, care should be taken while you are stirring so that air is not beaten into the solution. If water is poured on dry chemicals, they will cake and form hard lumps which are difficult to dissolve.

After accurately weighing the chemical, add it to the water while stirring, and continue to stir until the chemical is completely dissolved. Lumps or hard particles should be ground up, or crushed, with the stirring rod or with a pestle. Never add another chemical to a solution before the previous component has been completely dissolved. Sometimes there will be a residue which will not dissolve. The residue may be sand in the water supply, impurities in the chemicals, or other matter which found its way into the water. However, if the solution is allowed to stand for awhile these particles will usually settle and the clear liquid can be poured off. To remove sludge or dust particles which may not settle, pour the solution through a funnel containing three or four layers of cheesecloth or absorbent cotton.

Always add acids to the water. This is as easy to remember as AAA (Always Add Acid). It is generate heat rapidly enough to cause boiling, or a splashing explosion, which may splash solution on people nearby. Acids should always be poured slowly into a solution (near the edge of the container) while rapidly but carefully stirring the liquid.

LABEL ALL TANKS

Mixing, storage, and machine tanks for developer, stop bath, fixer, and other solutions must be labeled with waterproof tape or nameplates to reduce the probability of putting the wrong solution into a tank. The label should contain the name of the solution, the date it was mixed, and the name of the person who mixed it.

PREVENT CONTAMINATION

All mixing equipment and the mixing area must be cleaned immediately after use to prevent solution contamination. All mixing tools and tanks must be thoroughly cleaned right after they are used to prevent dried solutions from forming encrustations which could be dissolved when a new solution is mixed. Any mixing tools which have not been used in some time should be washed prior to use to remove any dust or dirt which may have accumulated.

PREPARATION OF PHOTOGRAPHIC SOLUTIONS

When mixing photo chemicals, you should always start with clean tools and a clean tank with the right amount of water—usually about one-half to three-fourths the final volume. The temperature of the water must be as specified in the instructions. Developers are generally mixed at about 90 to 125 °F while fixers are mixed in water which should not be much above 80 °F.

Always dissolve or dilute the ingredients in the order called for in the instructions or the formula. Dry ingredients must be completely dissolved before the next ingredient is added. All liquids must be completely diluted, while stirring, before the next ingredient is added.

After a liquid is added to a solution, the bottle should be rinsed and the rinse water also added to the solution so all the concentrated liquid is

After all ingredients have been combined and thoroughly dissolved, diluted, and mixed, water is added to bring the solution up to the correct volume. Do not forget to thoroughly mix this water into the solution.

FOLLOW DIRECTIONS

It is regrettable how many photographers throw away the instructions upon opening a container of film, paper, or chemicals when, by reading these instructions and following them, they could obtain consistent quality.

Before you mix any photographic chemicals you should carefully read the manufacturer's directions. Much effort went into the production of the chemical product but it is only effective if it is mixed and used the way it was designed to be mixed and used. The directions of even the most familiar product should be reviewed, as there are continuous attempts to upgrade photographic materials. For example, new film/developer combinations may call for changes in dilution, processing time, or temperature of solutions to get the required results. Following the directions is very important in the preparation of chemicals for both quality and safety reasons.

Remember to follow the proper procedures for chemical safety. You should prepare the chemicals in a well-lighted and well-ventilated room. Do not taste or inhale any chemical. You should wear rubber gloves, an apron, and a dust mask for your personal protection. Remember, for safe mixing and quality results, FOLLOW DIRECTIONS.

BULK CHEMICALS

An alternative to packaged chemicals is preparing your solutions by using available formulas (found in the *Photo Lab Index,* etc.) and bulk (i.e., raw) chemicals.

Using bulk chemicals requires following a formula that tells you the various chemical ingredients that must be dissolved into water. Unlike most packaged chemicals, the use of bulk chemicals calls for very precise measurement of each ingredient. This requires both care and a knowledge of measuring in order to carry out the directions.

Mixing solutions by referring to published formulas and using bulk chemicals can be advantageous. You can prepare solutions you rarely use (e.g., toners) or those which are not available in premixed form.

Chemical Grades

It is important when using bulk chemicals that you be aware of the standards of chemical quality. The American National Standards Institute (ANSI) publishes a series of standards covering all of the chemicals used in photographic processes. These ANSI standards contain specifications that establish the degree of purity and state limiting concentrations for potentially harmful impurities that may be present. You can prevent faulty processing caused by the use of chemicals of inferior quality by using only a grade of chemical that meets or exceeds these ANSI standards.

SOLUTIONS

Many chemical substances have no action when in contact with one another in the dry state. When they are dissolved in a suitable solvent, a chemical reaction begins immediately and continues until one of the chemicals is completely used, or until the solvent evaporates and allows the chemicals to dry again. Chemical solutions are prepared by dissolving a chemical substance in a solvent. The chemical being dissolved is termed the solute, while the liquid in which it is dissolved is termed the solvent. Water is the solvent used for most photographic solutions, so the word "water" is usually used in all descriptions and formulas instead of the term "solvent".

A solution may be defined, for photographic purposes, as a homogeneous liquid containing two or more distinct substances. The maximum strength attainable in a solution has a natural limit which is determined by the solubility of the solute to be dissolved. For example, 100 parts of ordinary water at 68 °F will completely dissolve approximately 36 parts of sodium chloride—common table salt. If more salt is added to the water, at this temperature, it will not dissolve, and the salt solution is termed a saturated solution.

The saturation point changes with the temperature; the higher the temperature of the solvent, depending upon the solubility of the solute concerned, the more chemical it will dissolve. As the solution cools, however, the excess chemical above a given temperature saturation point will quite likely be thrown out of solution, or said to crystallize out. Therefore, a saturated solution varies considerably in strength unless it is kept at the same temperature. This

is not always possible, so this type of solution is not used to any great extent. It is commonly replaced with the percentage solution, whose strength is the same at all usable temperatures.

A percentage solution is one which contains a definite number of parts per hundred of a chemical dissolved in a liquid, with the chemical weighed and the liquid measured precisely. For example, a 10 percent solution of sodium chloride in water would be made by taking 10 units, by weight, of sodium chloride and dissolving it in enough water to make the total weight of the solution 100 units. This type of solution is useful when you are measuring very small quantities of a chemical. Instead of trying to measure out 1 or 2 grains by weight, a given quantity of a percentage solution of the chemical is taken, and the result is more accurate as well as easily and quickly accomplished.

Changing Percentages

It is important for every photographer to know how to prepare percentage solutions from both dry and liquid chemicals. When small quantities of chemicals (less than 10 grains) are required by a formula, they are usually expressed as a number of ounces, drams, or cc^s of a percentage solution. A percentage solution indicates (as discussed earlier) the quantity of the chemical that is dissolved in water to equal 100 parts of a solution of the desired strength. Percentage solutions are prepared from dry chemicals by one method and from liquids by another method.

PERCENTAGE SOLUTIONS FROM DRY CHEMICALS.—To prepare a 10 percent solution of any dry chemical, dissolve 1 ounce of the chemical in 8 ounces of water. Then add water to make 10 ounces. For example, a formula calls for 2 ounces of a 10 percent solution of potassium bromide: Dissolve 1 ounce of potassium bromide in 8 ounces of water and add water to make 10 ounces; then measure out 2 ounces of the 10 percent potassium bromide solution and add it to the solution to be prepared by the formula.

Suppose, however, that only 5 ounces of a 10 percent solution of potassium ferricyanide is needed and you do not want to keep an extra 5 ounces of this solution around until it is needed. This chemical is in the dry crystalline form, so you should *multiply the amount wanted by the strength desired* (as a whole number rather than a fraction) *and then multiply the product by 4.4* (the conversion factor which gives the amount needed in grains[1]) to determine the amount of chemical that should be weighed out in grains; that is,

$$5 \times 10 \times 4.4 = 220 \text{ grains.}$$

If you dissolve 220 grains of potassium ferricyanide in 4 ounces of water and then add water to make 5 ounces, the strength of the 5-ounce solution is 10 percent.

Changing Concentration of a Liquid

When the chemical on hand is in liquid form and of known strength, a percentage solution can easily be prepared by the following method: *Multiply the amount wanted by the strength desired and divide the product by the strength of the chemical on hand.* For example, the formula being used calls for 11 ounces of 28 percent acetic acid. The chemical on hand is glacial acetic acid, 99.5 percent. Thus;

$$\frac{11 \times 28}{99.5} = \frac{308}{99.5} = 3.09 \text{ or } 3 \text{ ounces}$$

Add 3 ounces of 99.5 glacial acetic acid to 8 ounces of water to obtain 11 ounces of a 28 percent solution of acetic acid.

DISSOLVING CHEMICALS

Many chemicals are very sensitive to heat and even moderate temperatures will seriously affect their chemical properties. However, the rate of chemical reaction increases with an increase in temperature, and all chemicals dissolve more readily in warm water than in cool water. Consequently, many formulas and instructions recommend that water as hot as 125 °F be used

---

[1]The conversion factor of 4.4 is derived from the approximate number of grains in an ounce. There are actually 437.5 grains in an ounce, but for simplicity, this is rounded off to 440 grains. While this figure may not be arithmetically precise, it is accurate enough to give quality results without excessive mathematical manipulation. The factor 4.4 represents 4.4 grains or 1 percent of an ounce.

Some chemicals such as potassium metabisulfite, sodium bisulfate, and ferric oxalate should be dissolved only in cool water then added to the solution at the correct processing temperature.

If no specific temperature is recommended by a formula or instructions for the water in which the chemicals are to be mixed, you will do well to consider the following facts. Some chemicals give off heat when they are dissolved in water, while others absorb heat. If they give off heat, cool water should be used for preparing the solution, but if they absorb heat, warm or hot water should be used. For example, caustic alkalis and acids give off heat. Sodium thiosulfate absorbs heat. The most commonly used chemicals, such as sodium sulfite, sodium carbonate, and potassium bromide, produce only slight changes in the temperature of the water in which they are dissolved.

All items called for in the formula should be checked to ensure that a sufficient quantity of each is on hand to complete mixing the amount of solution needed. Each ingredient used in the solution should be weighed in the order given in the formula and dissolved by constantly stirring the water while each ingredient is being added. If the chemical is in crystal form, it may be necessary to crush the crystals with a pestle or the stirring rod. Each chemical should be thoroughly dissolved before the next is added to the solution. Be sure that the stirring rod or paddle used is not impregnated with oxidized or improper chemicals. The stirring motion should be constant and performed in such a manner that air is not whipped into the solution.

Weigh and/or dissolve each chemical called for in the formula or instructions. When all are dissolved, the solution should be practically colorless. Sometimes a solution appears cloudy or milky for a short time after it is mixed. This appearance may be caused by air taken into the solution by the dry chemicals. Air taken into a solution in this way is distributed through the solution as tiny bubbles which cannot escape while the solution is being stirred. If the presence

solution and escape into the air.

Some crystals, especially sodium thiosulfa (hypo), can be dissolved easily and quickly l suspending them in a cloth bag, which is secur near the top of the liquid. By suspending cryst in a liquid in this manner and not stirring, t crystals dissolve rapidly and the dissolv chemical sinks to the bottom of the containe This forces clear liquid to the top to receive mo of the dissolved chemical. Hypo crystals add to a solution in this manner are complete dissolved in approximately one-half the tin required to dissolve the same amount of th chemical in the usual manner.

During the mixing of photo processing chemicals, be sure to observe all precautionary information on the chemical containers and in the instructions. Wear eye protection, rubber gloves, and protective clothing such as a rubber apron. If chemicals come in contact with eyes or skin, wash the contacted area with plenty of water.

CHEMICAL SAFETY

Some of the chemicals used in photograp are skin irritants, and others can cause mo serious injuries. All chemicals should be regard as poisons and handled with caution. Prior handling or working with photographic chemica you should become familiar with the safe precautions contained in *Safety Precautions F Shore Activities,* NAVMAT P-5100.19 (Chapt 17, 18, and 20).

Due to the danger of contaminating t fingers, all precautions concerning poisons shou be observed when you are mixing photograp solutions.

Ingestion of poisonous chemicals may induced by smoking a cigarette with hands th are contaminated with a toxic chemical. precautions should be used to avoid contact ingestion of poisonous and/or corrosi chemicals. Regardless of the antidote given anyone that has been accidentally exposed to has swallowed a poisonous or corrosive chemic the antidote is for EMERGENCY USE ONL The affected person should report to t

dispensary and SEE THE MEDICAL OFFICER IMMEDIATELY.

ACIDS AND ALKALIS

There are many types of acids and alkalis used in Navy photo labs. In general, acids and alkalis are similar in their injurious properties in that either may cause the following:

- Corrosion (chemical burn) by direct contact with the skin or eyes or indirectly through the clothing.

- Intoxication or suffocation by inhalation of their fumes. The fumes of some compounds are toxic or poisonous while others will displace air, thereby producing a suffocating atmosphere.

- Poisoning when taken internally.

- Fire and explosion because of their instability under adverse storage conditions. Also, some acids are strong oxidizing agents which can generate ignition temperatures upon contact with organic materials and other chemicals.

Precautions

Certain precautions must be observed in areas where acids and strong alkalis are handled. These precautions are:

- Warning Signs and Labels—Signs should be posted in the chemical mix area, warning personnel of the principal hazards of the chemical being used. All containers must be properly labeled.

- Showers and Eye Fountains—Showers and eye fountains must be provided near the chemical mix area.

- Ventilation—Where injurious fumes are habitually generated by a fixed installation (chem mix room), permanent exhaust ventilation must be provided. In temporary chem mix areas either portable exhaust equipment or respirators may be used.

- Mixing and Diluting—Strong acids and strong oxidizing agents may react violently or produce explosive products; also, toxic gases may be evolved if acid is mixed with such chemicals as sulfides, cyanides, nitrates, and nitrites. Diluting acids with water can generate considerable heat; *acid should always be added to water,* not water to acid. The addition should be done slowly with constant stirring.

> You are perhaps tired of being reminded about chemical safety, but it must be stressed over and over again with the hope that you will make it a habit in your work. Safety can never be over stressed. Any accident brings hardship to everyone in the lab. To this end, here are some other *basic* safety procedures.
>
> - Never smell a chemical directly from the bottle. Instead, hold the bottle at a distance from your nose, and sniff its contents cautiously rather than inhale directly.
>
> - Never taste a chemical.
>
> - Handle all chemicals cautiously: many will produce burns or skin irritation.

CHAPTER 3

FILM PROCESSING

As a Navy photographer, you must realize that composing and exposing a scene is no assurance of top quality photography. The quality of the finished print is dependent to a great extent on the quality of your darkroom work. A perfectly exposed film is useless if it is fogged, scratched, or reticulated during processing or if it is under- or overdeveloped. It is, therefore, important that you master each step of film processing.

During our discussion of the *basic* film processing concepts, we will refer primarily to B&W film processing. Keep in mind, however, that these *basic* concepts apply equally as well to processing color films and B&W and color papers. The primary differences in processing color film as compared to B&W film are that, generally speaking, there may be more steps in a color film process and time and temperature requirements may be more critical. Later in this chapter we will discuss color film processing. Paper processing is covered in chapters 4 and 5.

DEVELOPERS AND DEVELOPMENT

The purpose of development is to blacken those parts of the light sensitive material (film or paper) which have been affected by light; this produces a visible image corresponding to the invisible latent image. Development is usually carried out by bringing the exposed film into contact with a solution which contains a developing agent but no silver salt. The silver which forms the developed image comes from a reduction of the individual silver halide grains in the film emulsion. This process is called *chemical* or *direct development*.

In another process, which is seldom used, the developed image is derived from a soluble silver salt contained in the developing solution itself. This process is called *physical development*. The physical development process is rather difficult to use; in particular, there is a tendency for silver to be deposited where it is not wanted.

In ordinary photographic practice the process of *chemical development* is employed, and this is the process which we are concerned with. In this process the individual silver halide grains in the film emulsion are reduced to a black metallic silver. Each grain in the emulsion acts as a unit, in the sense that a grain is either developable as a whole or is not developable. During *normal* development only exposed grains containing a latent image are reduced to black metallic silver. You may ask "Why doesn't the developer develop the unexposed as well as the exposed grains?" Actually, the unexposed grains are developable. If development were carried on over a long enough period of time, all grains would be developed or reduced to black metallic silver. Thus, development is a rate phenomenon, the development of the exposed grains taking place at a faster rate than the unexposed grains.

The individual grains of silver halide in an emulsion are protected against the action of the developer by a chemical layer. When light strikes the emulsion it tends to break down the protective layer at one or more points on each individual *light-struck* grain. When the exposed film is placed into the developer the grains are acted upon at these points by the developing agent, and each grain which received more than minimum exposure is quickly reduced to black metallic silver. The amount of blackening, or density as it is referred to, over the film surface depends primarily upon the number of grains which have been acted upon by the developer, although the density is also influenced by the fact that some grains which start to develop may not develop to completion in the time the developer is allowed to act on the film.

COMPOSITION OF A DEVELOPER

There are many different formulas used as developing solution, but most developers contain the following four essential ingredients—developing agent, preservative, accelerator or activator, and restrainer.

Developing Agent

The developing agent (reducing agent) is the most important chemical in a developing solution. Nevertheless, the other ingredients are necessary to make the solution function properly. Although several chemicals are capable of developing silver halides to metallic silver, relatively few of them can be used. Many chemicals tend to develop the unexposed as well as the exposed silver halides at the same rate; that is, some are not selective in their action. The few developing agents that are used vary greatly in their properties.

One of the properties of a developing agent is its reducing potential. This refers to its relative ability to develop or reduce the silver halides. A developing agent of high potential attacks silver halides vigorously, whereas, one of low potential is slower in its action. The characteristic activity of a developing agent is another factor to consider. Some agents are more active in the strongly exposed areas, some in the weakly exposed areas, and others have an equal overall activity. The temperature of the solution affects the activity of some agents much more than others. The tone of the developed image is greatly affected by the type of developing agent. Some agents produce blue-black or cold tones, while others yield brownish or warm tones. Hydroquinone, Metol, Amidol, glycin, paraphenylene diamine, and pyro are some of the more widely known developing agents.

Preservatives

All developing agents in an alkaline state have a strong affinity for oxygen. It is necessary, therefore, to add a preservative to developing solutions to prevent excessive oxidation. The preservative prolongs the useful life of the developing solution and prevents the formation of colored oxidation products which cause stains.

The preservative is a chemical which has a great affinity for free oxygen, and combines with it when mixed into a solution. A large amount

If the free oxygen is left in the water, it oxidiz most of the developing agent and produces stai before the metallic silver image is satisfactor developed. By the addition of a sufficient quant of preservative, practically all of the free oxyg is removed from the solution, the developi agent works as intended, and no stains produced.

Sodium sulfite is the preservative m commonly used. It also dissolves silver halides some extent, reduces grain size, and, therefo is useful in fine grain developers.

Accelerators

All developing *agents* (not developi *solutions*) are either neutral or slightly acid ar as such, they usually have little developing abili In order to utilize the developing capabilities these agents, it is necessary that they be in alkaline state. To make the developing *soluti* alkaline, an accelerator is added.

The accelerator has a double action. First hastens the swelling of the gelatin in the emulsio permitting the solution to penetrate the ent emulsion more quickly. The effect of this acti is physical. The second action is complet chemical. As the silver halogen salts in the late image are reduced by the developing agent, halogen elements freed from the silver absorbed by the accelerator and combined in neutral salts so they do not have any harm effects in the solution. These halogen salts ca some difficulty in one form or another if they not absorbed by the accelerator. In so developers the accelerator is utilized in t manner as a part of the developing agent, but final result is the same as if appearing as separ chemicals. It swells the gelatin to has saturation, and then absorbs the halogen salts they are released from the silver compound by action of the developing agent.

Because the accelerator is a determining fac in the activity of a developing solution, it ha marked influence upon the degree of grainin produced in the negative. This graininess dependent upon the clumping action of the sil grains during the development process. The m active the developer, the greater the clump action; therefore, milder or less alkal developers yield finer grain.

With no accelerator there is little or no action. With some accelerator there is too much action. By the addition of a bromide restrainer, the action of the developing solution is slowed down to a controllable degree, and the fogging effect produced when the developing agent's action is too energetic is prevented.

Restrainers

Without a restrainer most developing solutions act too rapidly and develop unexposed silver halides near the surface of the emulsion. This causes chemical fog, developing streaks, and an image with low contrast. In development, restrainer is released from the silver, and has a restraining action on the reducing agent. However, its action is usually insufficient to prevent fog. Therefore, a restrainer is added to the solution. When a restrainer is added, development time is prolonged and fog is minimized. Contrast is increased because the developing agent's activity is cut down in unexposed areas. However, excessive amounts of restrainer greatly retard development. The chemical most commonly used as a restrainer is potassium bromide.

The restrainer acts as a brake on the combined action of the developing agent and the accelerator. No accelerator known supplies exactly the required increase in developing speed. All accelerators produce more activity than desired. Therefore, to control the action, a restrainer is added to hold the action within usable limits.

The ideal developing solution is one that develops all the exposed silver halides in the emulsion and has no effect on any that are not exposed. When all of the exposed parts of an emulsion have been developed, the action should stop, even though the film is left in the solution. Unfortunately, no such solution is known. All solutions require attention during the processes in order to stop their action when the desired result has been produced.

TYPES OF B&W DEVELOPERS

As previously stated, when a photographic emulsion is properly exposed to light, there is an invisible change produced in the minute crystals of silver halide which results in a latent image being formed. To obtain a visible image, the exposed emulsion must be treated in a solution known as a developer. This solution converts the light-affected halides to black metallic silver. These black metallic silver particles form the visible image on the negative.

At the beginning of development, there is little difference in density between the highlight and shadow areas of the film. However, as development continues, this difference increases. Development should stop when the contrast between the various tones of light and shade reaches the difference desired. The activity of the developer and, to some extent, the type of film primarily determines this developing action.

One type of developer cannot cover all situations. For example, photographs exposed by poor lighting conditions may require a very vigorous developer to bring out as much of the image as possible, while a film exposed under normal conditions requires a normal working developer. There are many different developers, each one providing different activity and quality of development. The actual choice of the developer to use depends on the type of film, conditions under which it was exposed, type of negative required, and the developing time that is best for the method of development to be used.

General Purpose Developers

A developer for general purpose work should develop quickly to gammas of 0.65 to 0.90 and produce images of moderate grain. Clear areas of the negative as well as the image areas should be fog free.

> Gamma is commonly interpreted as a measure of the contrast reproduced in a negative image. That is, the ratio of negative contrast to original subject contrast for a given range of tonal values.

Some of the more popular general purpose developers are:

- DK-50
- DK-60a
- DK-76
- Microdol

Fine Grain Developers

All photographic images have a grainy structure. Although this grainy structure is not normally visible to the naked eye it becomes visible whenever large prints (enlargements) are made from a negative, especially if high magnifications are used. The tendency to use small negative sizes and make most prints by enlargement has resulted in the need for fine grain developers.

When enlargements are made from small negatives developed in other than fine grain developer, the grain of the film may be quite objectionable. Graininess in the film should be *controlled* in the development of the film. Keep in mind, however, that every film has its own grain structure or characteristics. For rollfilm and 35mm film, it may be best to always use a fine grain developer, because the negatives are so small that even with moderate enlargement the grain may be objectionable.

Fine grain developers achieve the desired result in several ways.

- They are usually soft working and this tends to minimize clumping of the silver grains.

> The grains of silver in a film emulsion may *appear* to be "clumped" because of the way they are distributed in the emulsion, but they may *actually* be clumped together, in physical contact, as a result of processing.

- Some fine grain developers actually produce smaller individual grains of black metallic silver. This however, tends to reduce the film speed.

- The grayish white images produced by some fine grain developers help by giving increased passage of light between individual grains. This results in less local variation in density.

- Most fine grain developers produce relatively low contrast negatives. A reduction in contrast in the negative tends to minimize the graininess of the negative. However, this may not contribute significantly to a reduction in the graininess of the final print. Any advantage achieved by lowering negative contrast may be offset by the need to use a higher contrast printing filter to print the negative.

Some of the more popular fine grain developers are:

- DK-20
- D-76
- Kodak Microdol-X

High Contrast Developers

To produce maximum contrast on process and line copy type films, a developer must produce density readily and be free from any tendency to produce fog within the time of development necessary for maximum contrast.

Some of the most popular high contrast developers are:

- Kodalith
- D-8
- D-11
- D-19

To prevent stain when using a high contrast developer the negative should be rinsed well between developing and fixing.

High Definition Developers

A high definition or compensating developer gives increased sharpness to the image by enhancing contrast of image edges and fine detail in the negative. High definition developers may increase film speed by one or two stops, but they also increase graininess. High definition developers are recommended for use only with fine grain (i.e., slow or medium speed) films.

Some of the high definition developers are:

- Acufine
- Ethol TEC.

> You should consult the film data sheets and/or the Photo Lab Index for the recommended developers for each particular type of film to be processed.

The function of a developer is to chemically change the sensitized material treated in it. It stands to reason then that a chemical change also takes place to the developer itself. Most developers are used more than once. Therefore, it is important to know what changes to the developer can be expected and what can be done to prevent them or at least compensate for them. The primary changes which occur to a developer as it is used are:

- Some developer is removed or carried out with the film, both on its surface and within the emulsion and on the film holding or processing apparatuses such as film hangers and reels.

- The developing agents are used up by reduction of silver halides to black metallic silver and/or by aerial oxidation. When the developing agents are used up by the reduction of silver halides, the byproducts of the reaction cause the pH of the solution to drop thus becoming more acid. When the developer agents are used up by oxidation, the pH tends to rise.

- The sulfite or preservative is used up thus the developing agents oxidize faster.

- The bromide within the solution is increased because bromide is liberated from the emulsion itself.

The effects of these changes to a developer are:

- The development time required to reach a given contrast ratio or gamma is increased. Therefore, if it is desired to use a developer over and over, the development time must be increased as more film is developed.

- The effective film speed produced by the developer decreases because of the increased bromide in solution. However, this speed loss may be partially offset by increased development time required to reach a given gamma.

Complete exhaustion of a developer occurs when the developing agents are all used up. The approach of exhaustion is characterized by a brown color of the solution. Since a developer in

Replenishment

In developing, such as is done in most Navy photographic laboratories, it is not economical to use a developer to the practical exhaustion point and discard it. Usually, the quality of the image falls off seriously, long before the exhaustion point of the developer is reached. For this reason, replenishers are usually used.

Replenishment of a developer should involve a continuous replacement of part of the used developer by a replenisher which maintains the consistency of the photographic characteristics of the film developed. The aim of replenishment is not to keep the composition of the developer constant but to keep its activity constant.

There are two commonly used methods of replenishment. The first, or "topping off" method is used extensively in tank processing. The developer solution is maintained at a constant level in the tank by adding replenisher so that the volume added is equal to the amount of developer carried out. With this method it is possible to maintain reasonable consistency of characteristics only for a certain period of replenishment. After a given volume of replenisher has been added to the developer, the developer is discarded and the procedure repeated with new developer.

The second replenishment method is called the "bleed" method. The bleed method is used primarily with machine processing where a circulating developer system is employed. Used developer is run off and replenisher (in proportion to the amount of film processed) is fed in continuously so that the level of the developer in the machine and its characteristics remain very constant.

FIXING, WASHING, AND DRYING

As soon as a light sensitive material has been developed it contains a visible silver image, but it is not ready to be brought into white light or be used for the further operations of making prints, etc. Only a portion of the silver halides in the emulsion is reduced to black metallic silver by the action of the developer. The silver halides which were not reduced impair both the immediate usefulness of the photograph and its

is called, the action of the developer should be stopped, or at least slowed down; for this we use either a water rinse bath or an acid stop bath.

When the light sensitive material is removed from the developer solution, there is a small amount of developer both in the emulsion and on the surface which must be removed or neutralized to slow down or stop the action of development and to prevent stains.

WATER RINSE BATH

To *slow* down the action of development the light sensitive material is treated (immersed) in a rinse bath. A plain water rinse bath is commonly used between development and fixation to *slow* down the development by removing all the developer which is clinging to the film (or paper) surface. A rinse bath does not completely stop development (an acid stop bath does). A rinse bath has little effect on the developer which is actually in the swollen emulsion.

Rinsing is accomplished by quickly immersing the film in plain clean water.

Following rinsing in plain water the material (which is still light sensitive) must be treated in an acid fixing bath to *stop* the development.

> A water rinse bath should be changed often to ensure that it does not become loaded with developer—or running water can be used.

The rinse bath, then, serves two purposes—first, it slows down development and second it lessens the work that has to be done by the acid in the fixer. Rinsing, therefore, protects or prolongs the useful life of the fixer.

ACID STOP BATH

Although a plain water rinse bath is commonly used between development and fixation, a better procedure is to use an *acid* stop bath. The function of a stop bath is not only to remove the developer which is clinging to the surface of the material but to also neutralize the developer in the swollen emulsion, thus completely *stopping* development. protect or prolong the life of the fixer by preventing developer carryover.

An acid stop bath should meet the following requirements:

- It should be sufficiently acid to neutralize the action of the developer carried over.

- Its acidity should be limited so the small amount carried over into the fixing bath with each film does not increase the free acid content of the fixing bath and cause sulfurization.

- It must not contain enough acid to produce blister formations in an emulsion.

It is advisable to use only a weak acid stop bath between development and fixation. Strong acid and the acid in the fixing bath has a tendency to form carbon dioxide gas bubbles in the emulsion when the film is taken from the developer and placed directly into a strong acid or fixing bath. These bubbles may break and cause small round holes in the emulsion. These are sometimes mistaken for pinholes like those caused by dust particles settling on the emulsion prior to camera exposure.

When using an acid stop bath remember that some of the stop bath will be carried into the fixer as materials pass through it. Therefore you cannot use strong acids (such as sulfuric acid) because these can cause precipitation of sulphur in the fixer. Acetic acid, the acid present in vinegar, is the type of acid used for stop baths. In its pure form as glacial acetic acid, 99.5 percent, it freezes at a temperature of about 61 °F. Its freezing tendency gives it the name "glacial." For use as a stop bath, 99.5 percent glacial acetic acid is diluted with water to about a 1-percent solution or approximately 1/2 ounce of 28 percent acetic (not glacial) acid to 32 ounces of water. Changing the concentration of a liquid was discussed in chapter 2 of this text.

FIXING

When a light sensitive material is removed from the developing solution, the emulsion contains a large amount of silver salt which has not been affected (developed) by the developing

allowed to remain in the emulsion, light ultimately darkens and discolors it and obscures the image. Obviously, if this action occurs, the negative (or print) is useless.

The fixing bath is used to prevent this discoloration and to make the developed image permanent. It accomplishes this by dissolving those silver salt particles that were not developed. Therefore, to make an image permanent, it is necessary to "fix" the light sensitive material by removing all of the unaffected silver salt from the emulsion.

All fixing baths must contain a silver halide (salt) solvent. This solvent is known as a fixer or fixing agent. The one universally used in photography is sodium thiosulfate, commonly termed *hypo*, which is taken from its other chemical name hyposulfite.

Sodium thiosulfate changes undeveloped silver halide to soluble silver sodium thiosulfate, removes this compound from the emulsion, and refills the space it occupied with nonexhausted fixing solution. The number of substances capable of functioning as fixing agents is small because a good fixer must meet the following requirements:

- It must dissolve silver salts without affecting the metallic silver image.

- The compounds it forms must be soluble so they can be removed from the emulsion.

- The fixer should neither excessively swell nor soften the gelatin.

Time Required for Fixing

The time required for film to fix depends on several factors:

- The type of emulsion and its thickness—Other things being equal, fine grain emulsions fix faster than normal or coarse grain ones. Thin emulsions require less time to fix than thick emulsions.

- Type of fixing bath and degree of exhaustion—When sodium thiosulfate is the fixing agent, a concentration of about 75 percent gives the fastest rate of fixation. However, because of the tendency of hypo to bleach out the image, most percent. When the concentration of sodium thiosulfate is above or below 75 percent, the rate of fixation is slower. A partially exhausted fixing bath works slower than a new bath. This is caused by a reduction in the concentration of sodium thiosulfate or hypo.

- Fixing bath temperature—An increase in the temperature increases the rate of fixation. (Do not interpret this to mean that you can raise the temperature of the fixer above the temperature called for by the particular process being used.)

> The temperature of the fixer is not as critical as that of the developer. However it should be used within a few degrees of the temperature of the developer to avoid reticulation of the emulsion and other processing problems.

- Amount of agitation—The rate of fixation is affected by diffusion of the chemicals, so that agitation reduces fixation time.

- Amount of exposure—The more exposure the film has had to light, the less unused silver halide to be removed by the fixer, and hence the faster the rate of fixation.

As a general rule, a film can be considered fixed after approximately twice the time required to *clear* it. Clearing or fixation occurs when all visible traces of the silver halides (a milky appearance) have disappeared. However, the exact moment of clearing is not easy to determine; therefore, the film should be fixed for twice the time it takes for apparent clearing to occur. Fixation of film is usually regarded as complete after about 10 minutes at 68 °F. (For paper (prints) fixation may be regarded as complete after about 5 minutes in a fresh fixer.)

Life of a Fixing Bath

The useful life of a fixing bath depends on several factors, one of which is the amount of material treated in the fixing bath. It is not possible to state with any degree of accuracy the exact amount of film or paper which may be

safely fixed in a given amount of fixer. It is, therefore, common practice to consider the bath expended when the clearing time for film in it is double the time required when it was fresh. (For a fixer used solely for prints this is not easy to tell; therefore, the life of the fixer is considered ended after a given amount of paper has passed through it. This is usually about 200 8 × 10 prints (or equivalent) per gallon of fixer). Fixing baths are usually made available for silver recovery (see Appendix I) when their useful life is considered ended.

Using an exhausted or near exhausted fixing bath may cause staining of films and paper. To avoid such staining, the best practice is to use two fixing baths in succession. Initially, two fresh fixing baths are used. The materials are treated in the first bath until they are just cleared, then they are transferred to the second fixing bath for an equal period of time. In time, clearing time in the first bath, which is doing most of the work of fixation, will be double the time required when the bath was fresh. When this occurs, the first bath is removed from use (do not forget to reclaim the silver) and replaced by the second bath, which, in turn, is replaced by a completely fresh bath. This process is repeated as required, with the result that the second bath is always relatively fresh. Using this procedure ensures that all film (and photographic paper) leaves the second fixer in good condition and will not fade in time. This method is also economical, in that all fixer is used to a point beyond that at which a single bath could be used.

WASHING

An unwashed or improperly washed emulsion will stain, crystallize, and fade; therefore, the washing of the photographic emulsion is just as important as any other part of processing. It is essential to remove as much of the salts and fixing agent chemicals from the emulsion as cost and time will permit. Only by good washing techniques can image permanence be assured.

The purpose of washing is to remove the soluble chemicals or solutions of the fixing bath. Fixing converts the silver salts into soluble compounds and removes them from the emulsion. Thus, if the fixing process is incomplete, even prolonged washing cannot render the image permanent because the compounds of silver sodium thiosulfate remaining in the emulsion discolor in time and produce stains. Thorough washing is necessary to remove the fixing agent which, if allowed to remain, slowly combines with the silver image to produce brownish yellow stains of silver sulfide and causes the image to fade.

Water containing iron should not be used for washing, however, impurities such as rust, dirt, or silt can be removed by using a filter in the water supply line.

Seawater may be used to wash negatives if it is followed with a freshwater rinse. Salt water removes the hypo from films in about two-thirds the time required for a freshwater wash. However, a short rinse with fresh water is required to remove the salt from the films. It is considered a safe and economical procedure to wash the film in seawater for one-half of the usual washing time and then rinse the film in fresh water for about 5 minutes with thorough agitation.

Factors Which Affect Washing Time

TEMPERATURE.—The wash should be kept within a range of 60 to 75 °F. Within this range of wash temperatures, the warmer the water, the shorter the washing time required. However, a wash temperature of 75 °F must not be exceeded. Water at temperatures above 75 °F swells the gelatin which tends to inhibit diffusion, while at the same time it may damage the emulsion. Therefore, it is better to keep the temperature of the wash water the same as that of the processing solutions.

CHEMICAL CONTAMINATION.—The addition of negatives fresh from the fixer into a tank of partially washed negatives undoes the effects of previous washing to such an extent that it becomes necessary to start the washing procedure again. The reason for this is that the negatives having the higher concentration of fixer add enough chemicals to the wash water to contaminate the partially washed negatives. This also occurs if chemically contaminated fingers are placed in the wash tank.

RATE OF WATER CHANGE.—The length of washing time required also depends on the diffusion of the hypo from the emulsion of the material. The rate of diffusion is dependent upon the amount of fresh water coming in contact with the emulsion. An idea of the actual rate of washing may be obtained if it is realized that the hypo remaining in the emulsion is continually halved in equal periods of time as the washing proceeds. For example, the average negative gives up about one-half of the hypo it contains in 1 minute if in direct contact with running water. After 2 minutes, one-fourth of the hypo remains, and so on, until eventually the amount of hypo remaining becomes negligible. Thus, the rate of washing depends upon the degree of agitation and the amount of fresh water that comes in contact with the emulsion. The minimum washing time for negatives in running water is 20 minutes when a complete change of the water occurs every 3 minutes.

If there is any question as to how long negatives should be washed, hypo tests should be conducted.

Hypo Tests

If hypo is present in the water drained from washed negatives, it can be detected by allowing some of the water from the negatives to drip into a test solution. It is extremely difficult to test for small quantities of hypo, but Kodak HT-1a test solution indicates when the film may be considered reasonably free of hypo. However, even when the test results in a negative reaction, it is still no guarantee of absolute image permanency.

To make Kodak HT-1a hypo test solution, use the following formula:

Distilled water	6 ounces
Potassium permanganate	4 grains
Sodium hydroxide	8 grains
Add distilled water to make	8 ounces

Take 8 ounces of pure water in a transparent colorless glass and add 1 cc (1 mL) of the test solution to it. Then allow some of the water to drip from a washed negative into the glass of solution. If a small percentage of hypo is present, the violet color of the solution turns orange in about 30 seconds; if a large concentration of hypo is present, the orange color turns yellow. In either case the film should be returned to the wash water and washed until further tests produce no change in the violet color.

DRYING

The final step in processing is to dry the wet film. This step should be given special attention. There are two distinct phases to film drying. The first is the removal of excess water from the film surfaces. The second is the drying of the film by evaporation.

After washing, water often drains from film in an irregular manner, clinging to both emulsion and base sides in drops, streaks, and uneven patterns. If such partially drained or incompletely wiped films are subjected to vigorous drying conditions as, for example, hot air or radiant heat, the areas under these streaks and drops of water dry much more slowly than the surrounding film. The swollen gelatin at these points is thereby subjected to stresses and shrinks unevenly, changing the density of the silver image. Even when surplus water is removed from the emulsion side, if drops of water remain on the base side, drying of the emulsion immediately opposite the water spots is retarded and drying marks may result. The proper use of wetting agents helps prevent the formation of these water spots which degrade the quality of the negative.

Wetting agents are chemicals, usually in liquid form, that "superwet" the film to promote faster and more even drying. Wetting agents are chemically different from soaps, but they perform a related function. They all lower surface tension of liquids so that film surfaces are quickly and evenly wetted. Kodak Photo-Flo is a typical wetting agent.

After washing, the film is bathed in a 1- or 2-percent solution of wetting agent, prepared according to instructions provided by the

manufacturer, for about 2 minutes. The film is then allowed to drain briefly (about 30 seconds) before drying. Wiping the film before drying with a damp chamois, sponge, or film wipe, to remove surface foam and excess wetting agent is a wise supplementary action.

The Drying Process

In the drying process, as with all other stages of processing, you must handle the film properly.

In drying films, the primary problems you must guard against are uneven drying, dust, scratches, and damage to the emulsion caused by overheating. Dry the film in a vertical position, hanging from a line or beam by film clips. With 35mm and roll film, curling can be avoided by hanging another film clip at the bottom of a strip of film. Film should not normally be dried in the hanger or reel in which it was processed, since *uneven drying will result.*

Dust and water spots are the problems you will encounter most frequently when drying films. If the dust is not imbedded in the emulsion, you can remove it with a camel's hair brush. Imbedded dust requires that the negative be rewashed and properly dried. Water spots are more serious, since uneven drying can cause not only white stains but also small craterlike formations in the film under each spot. The white stains can be removed with alcohol, but the craterlike spots become a permanent defect. The best cure is prevention. You can avoid these problems by keeping the film surface clean and clear, and by using a wetting agent rinse.

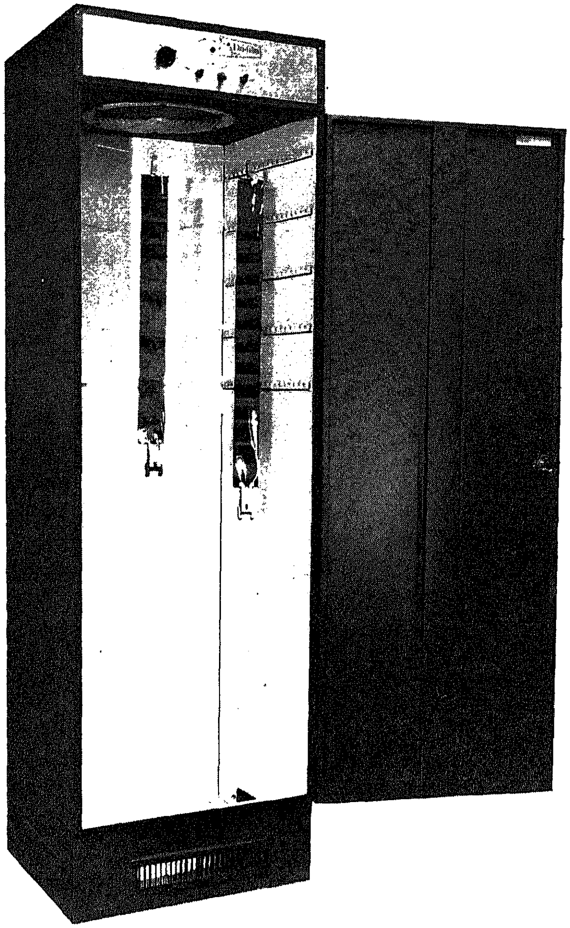
The photographic emulsion consists of one or more layers of gelatin with silver halides of varying sizes distributed through the layers. After exposure and development, the halides are changed to metallic silver which occupies space and does not absorb water. In an emulsion that is unexposed, the undeveloped silver salts are made soluble and are removed from the emulsion during the fixing and washing stages. Only the gelatin and the space occupied by the halides remain, and these do absorb water. Because of these conditions, dense negatives, or negatives containing many heavily exposed areas, contain less water and dry faster than thin negatives or negatives containing many lightly exposed areas. If you think about this for a moment, you can see that since the heavily exposed and lightly exposed areas are distributed randomly throughout the average negative, drying occurs rapidly in the dense areas, more slowly in the intermediate areas, and most slowly in the thin or unexposed areas. Obviously, then, negatives do not dry uniformly.

When gelatin dries, the water it contains must first migrate to the surface and then evaporate into the air. Ideally, these processes should take place simultaneously and at the same rate. However, if the surface moisture evaporates too rapidly, the surface becomes hard, and the internal moisture is unable to penetrate it. In addition, if drying is too rapid, the outer surface shrinks while the rest of the gelatin layer is in an expanded state. This causes strains which can have a harmful effect upon the emulsion.

In order for a negative to dry, it must be surrounded by dry air; that is, air which contains a lower relative percentage of moisture than the gelatin. Heated air will accept more moisture than cool air. But if the air does not move, even heated air can rapidly establish a state of equilibrium with the moist film, and drying will stop. Causing the damp air to move away from the surface of the wet film and replacing it with dry air will permit drying to continue. This is the principle behind the air impingement dryers currently in use.

In an air impingement drying system, air is warmed and blown against (impinges upon) the surface of the wet film. The warm, dry air picks up moisture and moves on. It is immediately replaced by more warm, dry air, and the process continues until the film is dry. The rate of drying is controlled by adjusting the velocity, temperature, and humidity of the air in the drying chamber. In very hot and humid climates where the air is saturated with moisture, the air must be passed through a dehumidifier before it enters the drying chamber. If this is not done, the film will not dry. In very dry climates it is necessary to reduce both the heat and the air velocity to prevent overdrying.

Photographic films begin drying at the corners and edges as well as in the areas of heaviest



Air impingement film dryer.

density. This introduces strains in the direction of the dry areas. As a film continues to dry, the strains gradually begin to equalize, and the film, if properly dried, ultimately lies flat. The surface is not moist to the touch but it is firm and soft enough that flexing does not damage it. If overdried, the film curls toward the emulsion and tends to be brittle.

The rate of drying and the amount of curl also depend upon how thick the emulsion layer is and whether or not the film has a gelatin backing. Naturally, the thicker the layer, the longer the drying time. A gelatin backing takes time to dry, but it introduces an opposing curl and causes the dried negative to lie quite flat.

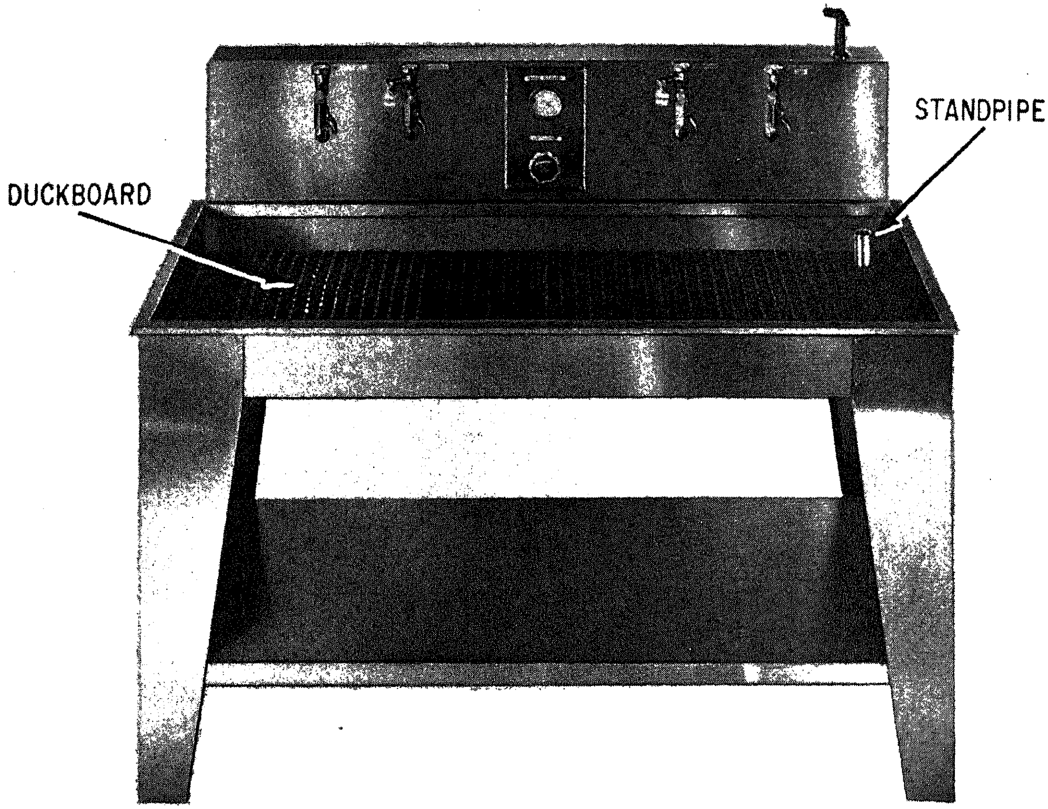
Hand processing of photographic film is best carried out in a properly equipped darkroom. Whether the darkroom is large or small, certain essentials are necessary for good quality processing.

The darkroom must be clean and well ventilated. Shelves, bottles, racks, processing equipment, walls, and floors which are spotted with dried chemicals are always detrimental to good photographic quality. Navy photo lab equipment, therefore, must be spotlessly clean at all times.

The arrangement of the darkroom should be convenient; "a place for everything and everything in its place". Sinks should be big enough and built so that they drain thoroughly. The sink should be equipped with duckboards to keep trays and tanks off the bottom and to permit water to circulate under and around the solution tanks to maintain correct and constant temperatures. There should be adequate and correct safelights placed at recommended working distances. Only necessary sensitized material should be in the darkroom. Temperatures in the laboratory should be maintained as closely as possible to the normal processing temperature—approximately 70 to 75°F. The well-equipped darkroom should contain the following items: waterproof aprons to protect clothing, clean towels, accurate thermometer and timer, and the necessary film hangers, trays, reels, and tanks. All darkrooms should be well stocked with prepared chemicals in properly labeled containers. In general, good photographic work demands that all operations be conducted in a clean, orderly, and systematic manner.

DARKROOM SINKS

As stated previously, sinks in the photographic darkroom should be of adequate size and proper construction. Most sinks in Navy labs are factory made and meet all the requirements of photographic work. Sinks should be watertight, drain completely, and allow circulation of water around and under tanks. Sinks should also have a mixing valve to control the temperature of the water in the sink and a standpipe to hold water



Photographic processing sink.

in the sink at the correct depth, yet still allow water to flow out.

SAFELIGHTS

The function of a safelight is to transmit the maximum amount of light that can be used safely without damage to the sensitized materials being processed. Since the color sensitivity of different sensitized materials varies, the color and intensity of the transmitted light must vary accordingly to be safe. Therefore, a photographic laboratory safelight is a combination of a rated light source and the designated filter to protect a specific sensitized material.

The word "safe," of course, is a relative term since no sensitized photographic materials are ever completely safe from the effects of safelight illumination. However, a filtered light is accepted as safe if the sensitized materials can be handled under the illumination with no evidence of fogging for at least twice as long as the normal processing time.

Two procedures must be followed precisely when safelights are used:

- Use only the size of incandescent bulb specified; e.g., 7 1/2 watt, 15 watt, or 25 watt.

- Handle the sensitized material at the distance recommended by the manufacturer's data instructions, usually between 3 and 6 feet.

To determine if a safelight is safe:

1. In the dark, place a sheet of unexposed film, emulsion up, on the working area where the film will be processed.
2. Place several coins on the emulsion and turn on the safelight. Leave the safelight on for twice the length of time the film will normally be processed.

3. Process the film normally and check to see if there is less density in the areas covered by the coins. If there is less density, this indicates fogging of the film by the safelight and the safelight is not safe. A safelight that causes fogging may be corrected by replacing the filter, installing a lower rated bulb, or increasing the distance between the safelight and the material.

The safelight filters in the following table are the ones most commonly used during black and white film processing. (The numbers are Kodak Wratten designations.)

Safelight Filters

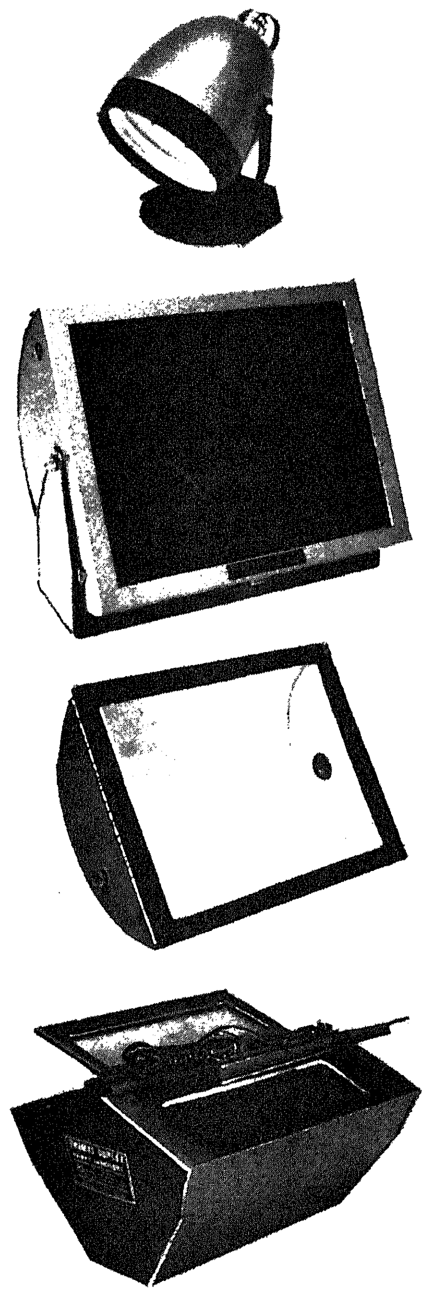
Filter Designation	Color	Use With
OA	Greenish Yellow	Black and White contact and duplicating materials and projection films
OC	Light Amber	Printing papers
No. 1	Red	Blue sensitive films
No. 1A	Light Red	Orthochromatic copy films
No. 2	Dark Red	Orthochromatic films
*No. 3	Dark Green	Panchromatic films

**Panchromatic emulsions should be processed under a No. 3 safelight with caution. The general practice, however, is to process panchromatic emulsions in total darkness. If a No. 3 safelight filter is used, the film should not be exposed to it until at least 50 percent of the developing time has elapsed, and then examined only momentarily at a distance of about 36 inches from the safelight.*

Any safelight is most efficient when its output of illumination is indirect or by reflection. If the safelight is not constructed on the indirect principle, the light should never be pointed straight at the sensitized material, but should be placed so that the light beam is away from or at an angle to it.

CAUTION

Panchromatic emulsions should not normally be processed under any safelight illumination. The use of time and temperature development only is recommended for panchromatic emulsions.



Safelights.

SHEET FILM HANGERS

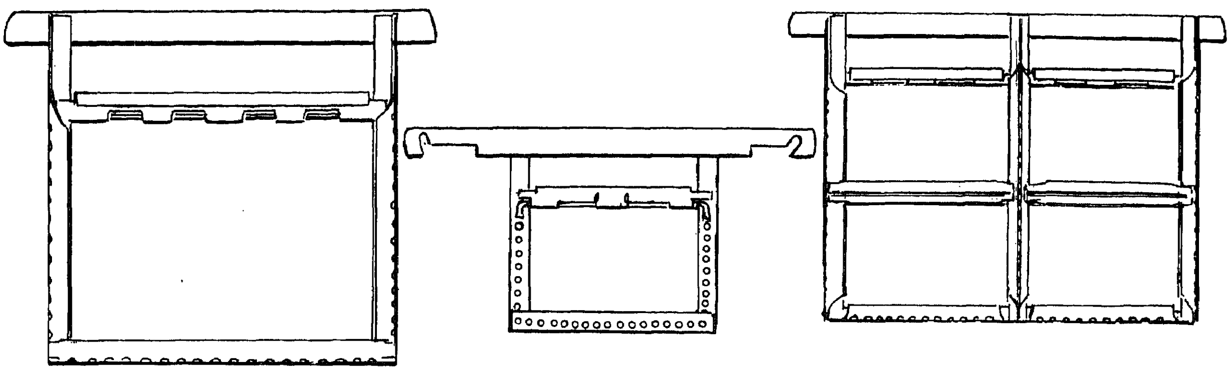
Sheet film hangers used to process exposed film are made of stainless steel or plastic that resists corrosion in the photographic solutions. They are constructed of perforated metal or plastic, channeled to receive and suspend the film in solutions, and to allow the solution to circulate freely over the film surface. Film hangers are used in tank developing and their use is described in the section of this chapter on "Tank Developing."

ROLLFILM TANKS AND REELS

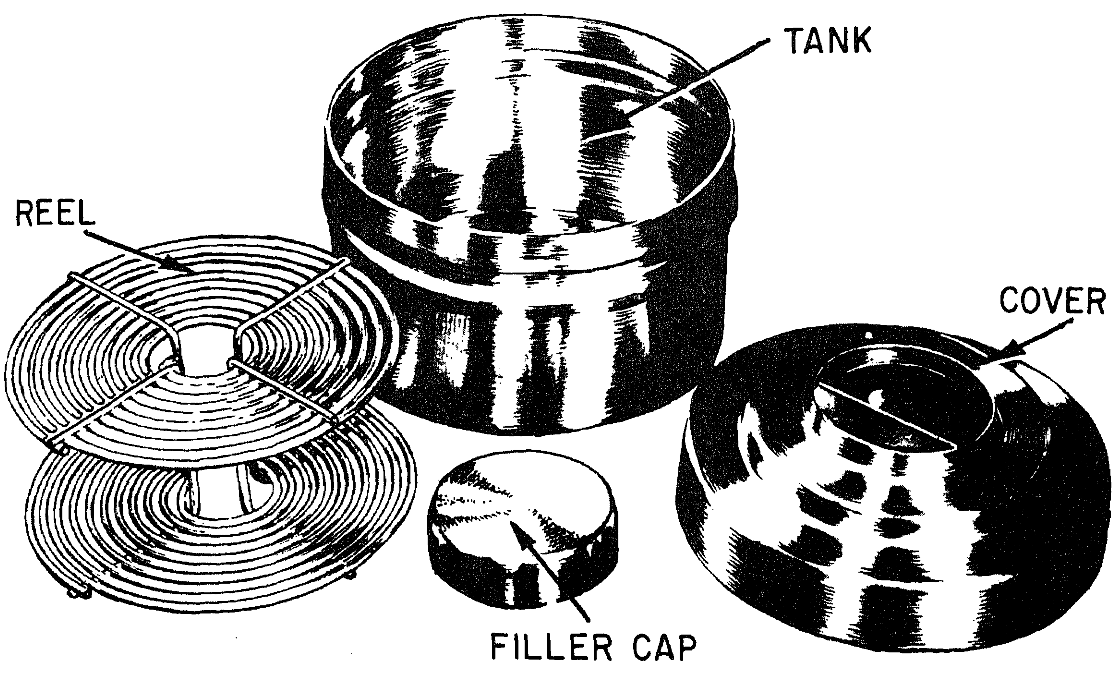
Hand processing of rollfilm is usually done on reels in rollfilm tanks. The reels and tanks most commonly used in the Navy are made of stainless steel. The reels are the center feed type. The film is wound onto a spiral reel. The reel is then placed into a tank for processing.

TRAYS

Trays used for processing photographic film (roll or sheet) are the same as those used for



Film hangers.



Rollfilm processing tank and reel.

processing photographic prints. They may be made of any material that will not be affected by nor cause contamination of photographic solutions. Most trays in use today are made of stainless steel.

SHEET FILM DEVELOPING TANKS

Tanks used for developing sheet film come in a variety of shapes and sizes. They are usually made of stainless steel.

To process sheet film in tanks, the film is first loaded into sheet film hangers which are then placed into the tanks of solutions.

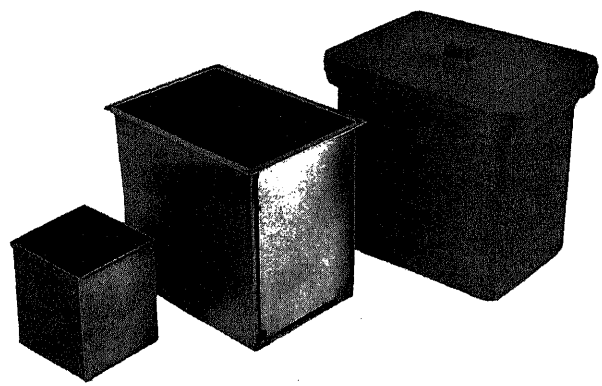
FILM WASHING EQUIPMENT

Film washing does not require any special equipment. Sheet films can be washed in the same type of tank used to process the film or in tanks designed for film washing, or they can be washed in a tray.

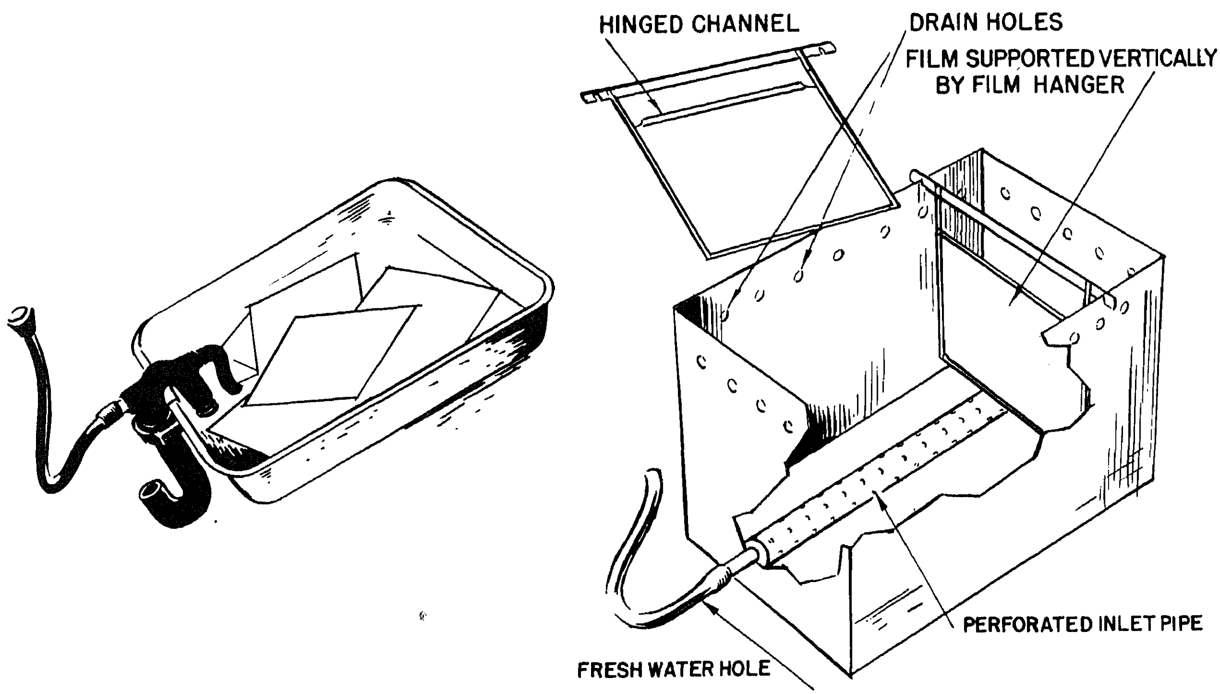
The two methods, then, of washing hand processed sheet film are the tank and tray methods. When a tray is used, only one film at a time *should* be washed. When more than one piece of film is washed at a time, the films will probably rub together and be scratched. Only line copy type negatives are usually washed in a tray.

The most effective tray method of washing is accomplished when a siphon device is attached to the edge of the tray. The device siphons water from the bottom of the tray while fresh water enters at the top.

The best way to wash hand processed sheet film (especially more than one sheet at a time) is in a sheet film washing tank. Film hangers hold the individual negatives suspended separately in the tank. Fresh water flows into the bottom of the tank and runs out around the sides at or near the top of the tank. When the film hangers are



Sheet film developing tanks.



Film washing methods.

placed into the tank, care should be taken to make sure the negatives are separated so that sufficient fresh water reaches all areas of each negative.

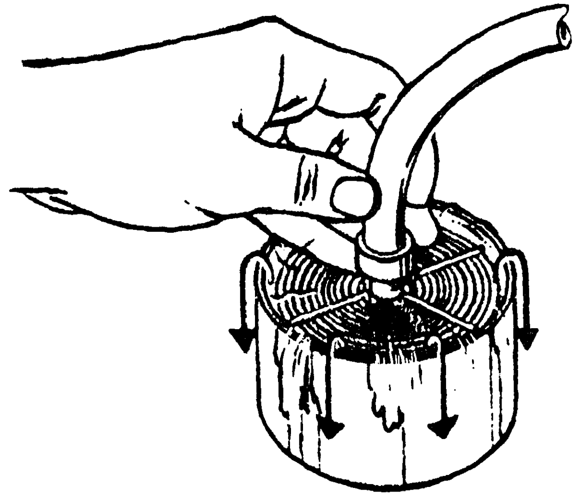
A rapid rollfilm washer is excellent for washing hand processed rollfilm.

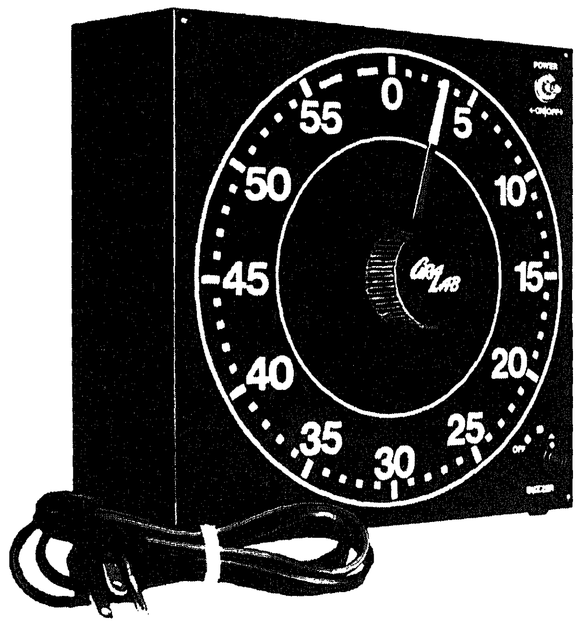
A rapid rollfilm washer is a cylindrical tank, large enough to hold several spiral reels. The washers come in a variety of sizes that will wash from two 35mm reels to as many as about six or eight 120 reels.

The rapid rollfilm washer is constructed so the wash water is introduced into the tank at the base and flows up through the tank and around the film at a rapid rate. By discharging the water from the top of the tank, more hypo is removed in a short period of time than if the water enters and leaves the tank at the top.

Rapid rollfilm washer.

Rollfilm can also be washed in the rollfilm tank in which it was processed. To wash rollfilm in a rollfilm processing tank, simply push a small hose well down into the center of the reel and have the faucet on so that the water overflows steadily from the tank.





Courtesy of Dimco-Gray Company.

TIMERS

Every darkroom should be equipped with a reliable timer. Ideally the timer should have both a minute hand and a sweep second hand. The timer most commonly used in the Navy is a Gray Lab timer. Not only does this timer have a minute and sweep second hand, but the numbers and hands are fluorescent so they can be easily seen in the dark. A Gray Lab timer also has an alarm

(buzzer) which indicates when the time for processing is up.

PROCESSING METHODS

No matter how many rolls or sheets of film you develop, it helps if you carry out the processing in three distinct phases, beginning with preparation. First, the area where you work must be clean, with all the equipment you use arranged so that it is near at hand and easy to find in the dark. The second phase is processing. If you are not familiar with darkroom work it is helpful to go through ALL the processing steps, with dummy or practice film and water to substitute for processing solutions, in white light and then a few times in the dark. The third phase is film drying.

As you know, to make the latent image visible and permanent, the film is processed in different chemical solutions. There are five steps in the processing phase. The first step is development. In this step the film is placed in a developer which transforms the latent image into a visible black metallic silver image. In the second step the developing solvents are neutralized, and development is retarded or stopped by a rinse bath or stop bath respectively. The third step involves placing the film into a fixing bath to remove the light sensitive, undeveloped silver halides. The fourth step is to wash the film to remove all the chemicals, and the last step is to dry the film. Each of these steps will be explained in detail, as we progress in this chapter, since there are certain controls that must be applied to each step.

Some of the processing steps may be carried out in white light, while others *must* be done under appropriate safelight conditions or in total darkness. Those steps which must be done in darkness or under suitable safelight conditions begin when the film package, holder, or roll is opened and end when the film is removed from the fixer.

The steps and the lighting conditions under which they are carried out are:

1. Development—dark or appropriate safelight
2. Rinse or stop bath—dark or appropriate safelight
3. Fix—dark or appropriate safelight
4. Wash—white light
5. Dry—white light

In addition to exposure, there are four factors in development which control image density, contrast, and, to a limited degree, the uniformity of individual densities in a negative. These four factors are the type of developer used, development time, temperature of the developer, and agitation—both the amount and method.

- Type of Developer—One type of developer cannot cover all film exposure/processing situations. For example, film exposed under poor lighting conditions may require a vigorous developer to bring out as much image detail as possible, while film exposed under normal conditions requires a normal working developer. There are many different developers, each one providing a different activity and quality of development. The actual choice of the developer to use depends on the type of film, conditions under which it was exposed, type of negative required, developing time that is best for the method of development to be used, and manufacturer recommendations.

- Time and Temperature—Many factors must be considered if you want to ensure correct development during film processing. Two of these factors are the length of time the film is allowed to develop and the temperature of the developer solution. Both of these factors can have a significant impact on the quality of the processed film.

As described earlier, the activity of a developer increases as its temperature increases. Film development carried out for a given time at a given temperature produces both predictable and desired results—assuming, of course, that the film has been given proper exposure. When film is developed for a given time at a given temperature, it is called "time and temperature development."

In the time and temperature method of film processing, as in any method of film processing, if the film is developed for too short a time or at too low a temperature, a weak, low density negative will result. Underdevelopment can result in a loss of detail in the shadow portion of the image. On the other hand, if the negative is developed for too long a period or at too high a temperature, the result would be a negative having too much density. The developer solution would overdevelop the exposed areas and might even develop some of the unexposed halides.

2-81

PROCESSING PROCEDURE

With agitation, develop, [illegible], and fix at 65 to 75°F (18.5 to 24°C).

1. Develop [illegible]

Kodak Packaged Developers	Suggested Developing Time (in Minutes)*									
	TRAY (Continuous Agitation) or TANK† (Gaseous-Burst Agitation‡)					TANK† (Agitation at 1-Minute Intervals)				
	65°F 18.5°C	**68°F 20°C**	70°F 21°C	72°F 22°C	75°F 24°C	65°F 18.5°C	**68°F 20°C**	70°F 21°C	72°F 22°C	75°F 24°C
HC-110 (Dilution B)	6	**5**	4¾	4½	4	8	**7**	6½	6	5½
Polydol	7	**6**	5½	5	4½	9	**8**	7½	7	6
Microdol-X	9	**8**	7½	7	6	11	**10**	9½	9	8
D-76	7	**6**	5½	5	4½	9	**8**	7½	7	6
DK-50 (1:1)	5	**4½**	4¼	4	3½	6½	**6**	5¾	5½	[illegible]

*With [illegible]erly exposed film, these suggested developing times should yield [illegible] suitable for printing w[illegible] diffusion enlarger or by contact. For printing with [illegible]ger, a lower contrast (achieved by a [illegible] [illegible]plete information about contrast control, see Kodak Publication [illegible] *Black-and-White Films.*
†Unsatisfactory uniformity may result with development times shorter than 5 minutes in a tank.
‡1 second every 10 seconds; pressure to raise solution level ⅝ inch (16 mm).

Note: Do not use Kodak Developer DK-20 or other developers containing silver halide solvents, such as thiocyanates or thiosulfates.

2. Rinse: Kodak Indicator Stop Bath—30 seconds **or** Kodak Stop Bath SB-5—30 seconds.

3. Fix: Kodak Fixer—5 to 10 minutes **or** Kodak Fixing Bath F-5—5 to 10 minutes **or** Kodak Rapid Fixer—2 to 4 minutes.

4. Wash: For 20 to 30 minutes in running water at 65 to 75°F (18.5 to 24°C). To minimize drying marks, you can treat in Kodak Photo-Flo Solution after washing. To save time and conserve water, you can use Kodak Hypo Clearing Agent.

5. Dry in a dust-free place.

Mechanized Processing: For information write to Kodak in your country. In U.S.A., write to Eastman Kodak Company, Rochester, N.Y. 14650.

Storage: Keep the unopened package in a cool place (65 to 75°F [18.5 to 24°C] or lower). Process film as soon as possible after exposure.

The Kodak materials described in this publication for use with Kodak Plus-X Pan Professional Film 4147 (Estar Thick Base) are available from those dealers normally supplying Kodak materials. Equivalent materials may be used if desired.

Notice: This film will be replaced if defective in manufacture, labeling, or packaging. Except for such replacement, the sale or any subsequent handling of this film is without warranty or liability even though defect, damage, or loss is caused by negligence or other fault.

DEUTSCH

• Panchromatischer Film von mittlerer Empfindlichkeit • Maßhaltige 0,18 mm Estar Unterlage • Feinkörnig, hohes Auflösungsvermögen • Ausgezeichnete Schärfe bei Vergrößerungen • Beidseitig retuschierbar.

Dunkelkammerbeleuchtung: Die Verarbeitung muß bei völliger Dunkelheit erfolgen. Nach der Hälfte der Entwicklungszeit kann jedoch eine Kodak Dunkelkammerlampe mit einem Kodak Dunkelkammerfilter Nr. 3 (dunkelgrün), oder einem ähnlichen Filter und einer 15-Watt Lampe im Mindestabstand von 1,20 m Film für wenige Sekunden eingeschaltet werden.

BELICHTUNG • Empfindlichkeit

ISO 125/22°
ASA 125/22 DIN

Tageslicht-Belichtungstabelle für mittelhelle Motive:

Verschlußzeit 1/250 Sekunde

Helle oder dunstige Sonne auf hellem Sand oder Schnee	Helle oder dunstige Sonne (deutliche Schatten)	Schwache, dunstige Sonne (weiche Schatten)	Bewölkt aber hell (keine Schatten)	Offene Schatten† oder stark bewölkt
f:16	*f*:11*	*f*:8	*f*:5,6	*f*:4,0

**f*:5,6 für Nahaufnahmen bei Gegenlicht.
†Motiv im Schatten, aber unter klarem Himmel.

2

Courtesy Eastman Kodak Co.

Time and temperature developing chart in a film data sheet.

ture, or temperature can be adjusted for a given time.

There is a definite correlation between time and temperature. When it is impossible to maintain solution temperature at the desired level, time can be shortened or lengthened to compensate. As the temperature rises, developing time must be decreased to provide equivalent development. As the temperature drops, development time must be increased.

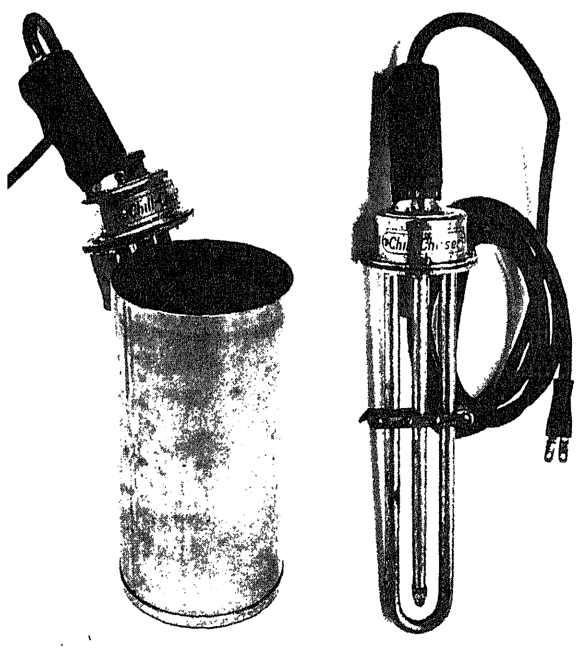
The normal temperature for hand processing black and white film is 68 °F. There are several reasons for this standardization. At a temperature of 68 °F, the gelatin swells sufficiently to allow adequate penetration of the developing solution, without oversoftening to the point where it is easily damaged (which occurs at higher temperatures). Temperatures lower than 68 °F tend to slow development excessively. Only when time is of the utmost importance are accelerated temperatures used. In most instances when very high temperatures are used, the film is treated in a hardening bath prior to processing. Since a several degree rise in temperature shortens development only a small amount, there is little to be gained by deviating from standard processing temperatures.

If you know the time and temperature relationship for a given film/developer combination, processing in total darkness becomes relatively simple. You simply adjust solutions to the prescribed temperature and then process for the required time. Assuming proper exposure, time and temperature processing can produce a correctly developed negative without your having to see what is happening in the solution.

All solution temperatures (developer, rinse, fix, and wash) should be as near to each other as possible. If there is considerable difference in the temperature of the solutions, the emulsion is subjected to excessive expansion and contraction which may cause it to wrinkle and/or crack. This effect is called reticulation. Normally, it renders the negative useless for printing, since reticulation is not correctable.

The temperature of solutions may be adjusted by surrounding them in any convenient manner with hot water, cold water, or ice, as the case may require. Never add water or ice directly to a solution because it dilutes the developer to an unknown degree. Ice may be placed in a container

- Agitation—If a film is placed in a developer and allowed to develop without any movement, the chemical action soon slows down because the developing power of the solution in the emulsion and in contact with its surface becomes exhausted. If the film is agitated, however, fresh solution is continually brought to the film surfaces, and the rate of development remains constant. Therefore, agitation also has an important effect on the degree of development. An even more important effect of agitation is that it prevents uneven development. If there is no agitation, the exhausted solution, which is contaminated with bromide from the emulsion, may flow slowly across the film from the dense highlight areas and produce streaks. Consequently, the statement of a developing time and temperature means very little if the degree of agitation is not also given. Constant agitation is usually recommended for the first minute or two of tank development, and for the entire



Immersion heater.

developing time when processing in a tray. After 1 minute of tank development, the usual recommendation is that the film be agitated at least once every minute during the remaining time.

The time, temperature, and amount of agitation required for a film/developer combination are recommended by manufacturers of the film and/or developer. These recommendations may be found with the instructions which accompany the film and/or developer or in the Photo Lab Index.

> Development by Inspection
>
> In developing by inspection, the film is viewed by light from a suitable safelight, and the appearance of the image is watched. Development is stopped when the negative is judged to have suitable densities. Developing film to the desired degree by inspection requires a great deal of experience on the part of the photographer.
>
> The ease with which development by inspection may be carried out depends largely on the safelight used and on the color sensitivity and speed of the film being developed. With monochromatic films the method presents no difficulty. With orthochromatic films, however, where only a dark red safelight is used, judgment of negative quality and density is much more difficult. With panchromatic film, any attempt at development by inspection is accompanied by a high risk of fogging the film.
>
> It is suggested that the beginner expose and develop test films of various types using the time and temperature method of development. After the film is developed normally, place it in the stop bath. These test negatives are then examined by suitable safelight in order to observe their characteristic appearance. Films being developed by inspection, and the test negatives, should be examined by reflected light from the safelight on both the emulsion and base sides.
>
> When you develop by inspection, care should be taken not to expose the film to the safelight more than is actually necessary. Unless the film is excessively overexposed, the first half of the recommended developing time should be carried out in total darkness. After this, the safelight may be turned on for short periods of time and the film inspected. Care should be taken that the proper safelight filter and bulb are used, and that the film is not held closer than recommended to the safelight. Otherwise, the film may become fogged.

There are basically three different methods of processing film by hand. These are: the *tray*, the *sheet film tank*, and the *rollfilm tank*. Each method is discussed here, along with an example of the darkroom arrangement used.

TRAY DEVELOPING

The tray method is used primarily for processing a few sheets of line copy film. It can be used to process other types of sheet film; however, the tendency for the film to become damaged with scratches and gouges is too great for orthochromatic and panchromatic film processing and, therefore, is not recommended. The tray method should not be used to process rollfilm either.

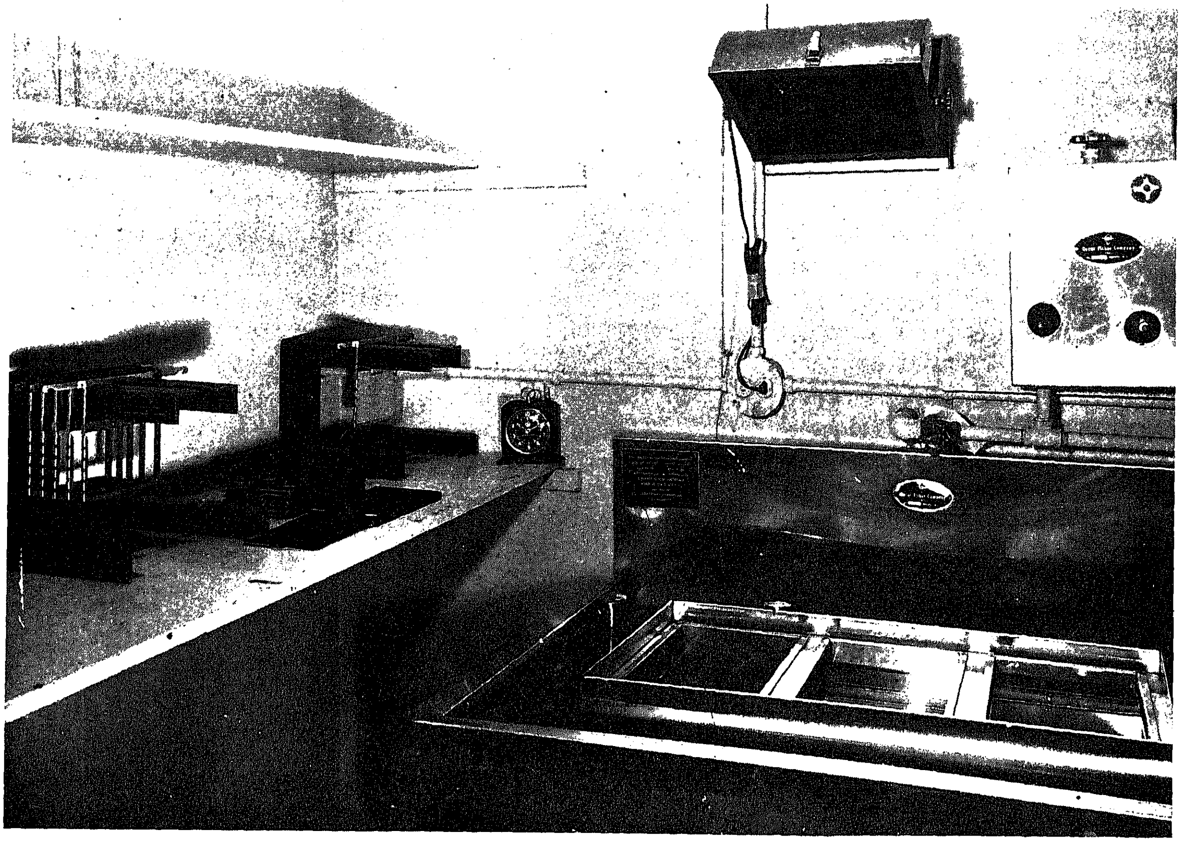
Although, with a lot of experience, as many as 6 or 12 sheets of line copy film can be processed in a tray at one time, it is far better to work with only a few sheets at a time and repeat the process than to start all the films at the same time and damage them. And damage the film you will—no matter how good you are (or think you are) at processing in a tray, if you try to process more than one sheet of orthochromatic or panchromatic or more than a few sheets of line copy film at a time.

The tray processing method described here has proven satisfactory under most conditions for processing one sheet of film at a time. We recommend you use it as described, and skill MUST be gained using this procedure before you attempt to use variations.

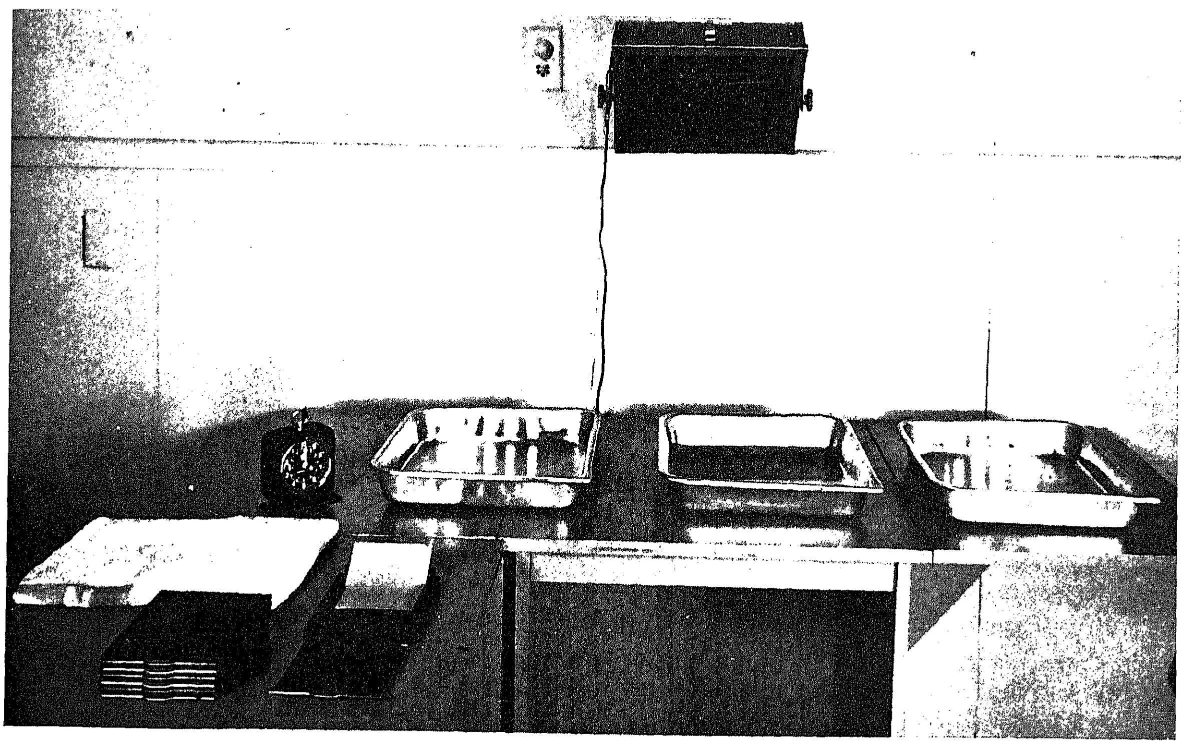
The processing steps and equipment discussed earlier are applicable to tray processing.

The trays should be appreciably larger than the film to be processed. For example, 4×5 film should be processed in 8×10 trays, 8×10 film in 11×14 trays, and 11×14 film in 16×20 trays, etc. Ideally, the trays should be arranged in a shallow sink which contains temperature controlled circulating water. The trays can also be arranged on top of the counter. In either case, the trays should be arranged with the developer to your left as you face the trays. The stop bath goes next to the developer, follwed by the fixer and the wash tray.

> In all Navy photo labs it is standard procedure, when processing film (or prints) by hand, to work from left to right.



Arrangement for tank processing sheet film in a sink.



Arrangement for tray processing on counter top.

Rinse the trays with fresh water as a precaution against contamination, and prepare the solutions. When the solutions are ready, place the exposed film holder to be unloaded on a clean, dry area of the workbench near the developer. Set the timer for the correct developing time and place it in a convenient location near the processing solutions. Then, if you are processing panchromatic film, turn out all the lights. If you are processing monochromatic or orthochromatic film, you may be able to use a suitable safelight.

Remove one sheet of film from the holder and submerge it quickly, emulsion side down, into the developer. Then immediately turn it over (emulsion up) and slide it back under the surface of the developer quickly, and agitate vigorously to eliminate any possible air bubbles. The surface of the film must be wetted quickly and evenly, otherwise developing marks may result. Start the timer just before the film is placed into the developer.

During tray development, the tray should be rocked continuously to provide constant agitation. Care must be taken to make sure that the tray rocking is not too fast and that it is varied at intervals—e.g., first to and fro, then side to side—to avoid patterns of uneven development caused by regular waves.

CAUTION

Do not allow your fingernails to touch the film emulsion at any time.

Tray development is considered to involve constant agitation, and development time is usually approximately 20 percent less than if the same film were being developed with intermittent agitation, as when sheet film is developed in film hangers in a tank. If tray agitation is done very slowly, the agitation should be considered intermittent and the developing time adjusted accordingly.

When the timer rings, remove the film from the developer, and submerge it in the stop bath. Agitate the film in the stop bath for about 5 seconds, then transfer it to the fixer. It is necessary to agitate the film vigorously in the stop bath and initially in the fixer because gases are released in these solutions and there is danger of gas bubbles forming on the film surface. If these gas bells or bubbles are allowed to form, they may cause dark spots. This is due to the continued action of the developer under the bubbles. Agitate the film in the fixing bath for a few seconds and then the safelights or the white lights may be turned on. Continue agitating the film until it loses the cloudy or creamy appearance. Note the time required for this change to occur because it is just half the total required fixing time. Agitate the film several times during the second half of the fixing time. After the film clears, continuous agitation is not necessary.

After fixing is completed, transfer the negative to the wash water and continue to agitate it unless a regular film washing tank or tray is available. The negative may be put in a regular film hanger for washing. If so, the hanger should be loaded while underwater to avoid scratching the films with the dry hanger. Usually, when developing is done by tray, the washing is also done by tray.

After washing is complete the film should be treated in a wetting agent and dried.

> Another way to process one film at a time in a tray is to tape the sheet of film, at the corners, emulsion up, in a dry tray. Then quickly and carefully pour in the developer. After development time has elapsed, quickly dump out the developer and pour in the stop bath; dump it and put in the fixer. Agitate by gently rocking the tray.

As we stated earlier, with experience you will be able to process several sheets of line copy film at a time in a tray. When processing several films in a tray at a time, there is an added step. This is a predevelopment rinse in clean water, which should be at the same temperature as the rest of the processing solutions. The predevelopment rinse is located to the left of the developer. Its purpose is to prevent the films from sticking together in the developer.

The procedure then for processing more than one sheet of line copy film at a time is:

1. When the solutions are ready, place a dry, dust-free paper or cardboard on the workbench near the predevelopment rinse. Place the exposed film holders near this clean working space.

2. Set the timer.

3. Turn out the lights.

4. Remove one film from its holder and place it, emulsion down, on the clean paper. Remove the second film and place it, emulsion down, on top of the first. Continue until all films to be developed have been placed in a loose pile on the space provided for them.

5. Pick up the film on top of the pile with the left hand (keep the left hand dry until all films have been placed in the water), drop it, emulsion side down, into the water, and immerse it quickly with the right hand. Pick the film up immediately, turn it over, emulsion up, and push it back under the solution. Place the wet film, emulsion side up, at one end of the tray. Immerse the next film in the same manner. Stack it on top of the first film, and continue with this procedure until all the films are stacked in a pile at one end of the tray. The left hand should follow the last film into the tray, to assist in the agitation of the films.

Wet film may be handled with wet fingers. However, extreme care should be taken to KEEP WET FINGERS OFF DRY FILMS. Slight pressure with the balls of the fingers is not harmful to a wet emulsion unless it has swollen excessively.

The films should be agitated or shifted constantly to prevent the individual sheets from sticking together. Agitation is accomplished by moving the first film from the bottom of the stack and placing it on top, or by starting a new stack at the other end of the tray. Continue agitating the films from bottom to top until they become completely saturated with water—about 1 or 2 minutes is sufficient. After the emulsion is completely saturated, the danger of films sticking together is no longer a problem.

6. Remove the films, one at a time, from the predevelopment rinse and immerse them in the developer. Place the films in the developer, emulsion side up; slide them under the surface of the solution quickly, and agitate them vigorously to eliminate any possible air bells. Start the timer just before the first film is placed in the developer. Use the left hand to remove all films from the water, and be careful not to get the water contaminated with developer. The left hand should follow the last film transferred from the water into the developer, to assist with the agitation.

It is important to be able to quickly locate the first film placed in the developer. Thus, aline the long dimension of all subsequent films at a right angle to the first film placed in the developer.

The films are immersed, emulsion side up, in the developer to minimize the greater damage which would occur if the emulsion, already softened by presoaking, were allowed to come in contact with the bottom of the tray. Be careful not to dig or drag the corner or edge of any subsequent films into the emulsion surface of the film below it. Do not allow the fingernails to touch the emulsion at any time. Stacking films by alining their edges against the sides of the tray helps reduce scratches and abrasions.

7. Agitate the films constantly, not by rocking the tray, but by moving each film in turn from the bottom of the stack and placing it carefully on top, and pressing it down gently to assure a flow of solution over its surface. Continue this procedure until the developing time is up.

8. When the timer rings, remove all the films from the developer, one at a time, in the same order in which they were placed in the developer, and submerge them in the stop bath. The right hand should go into the stop bath with the first film and stay there to handle each film as it is transferred from the developer by the left hand. Use the left hand only to transfer the film in order to avoid contamination of the developer and spotting of the film. A few drops of developer do not materially affect the stop bath, or the fixing bath, but a few drops of either of these solutions ruin a developing solution.

9. After all the films have been shifted several times in the stop bath, they should be transferred individually to the fixing bath or hypo. Shift the films several times in the fixing bath, agitating them vigorously. Then safelights or the white lights may be turned on. Continue shifting the films until they lose the cloudy or creamy appearance. You must shift the films several times during the second half of the fixing time, but continuous agitation is not necessary.

10. After fixing is completed, transfer the negatives to the wash water and continue agitation unless a regular film washing tank or tray is used. The negatives also may be put in regular film hangers for washing.

11. Treat the film in a wetting agent and dry it.

As we stated earlier, if you process more than one sheet of panchromatic or orthochromatic film at a time in a tray, you will damage the film. But since we know most of you will try it anyway (as most of us have), try it with some sheets of test film first (seeing is believing). Do not process several sheets of orthochromatic or panchromatic film at one time in a tray if it is important to a job you are doing.

Keep this in mind—if the job requires the quality only available from sheet film, it also requires the quality available from proper processing.

TANK DEVELOPING SHEET FILM

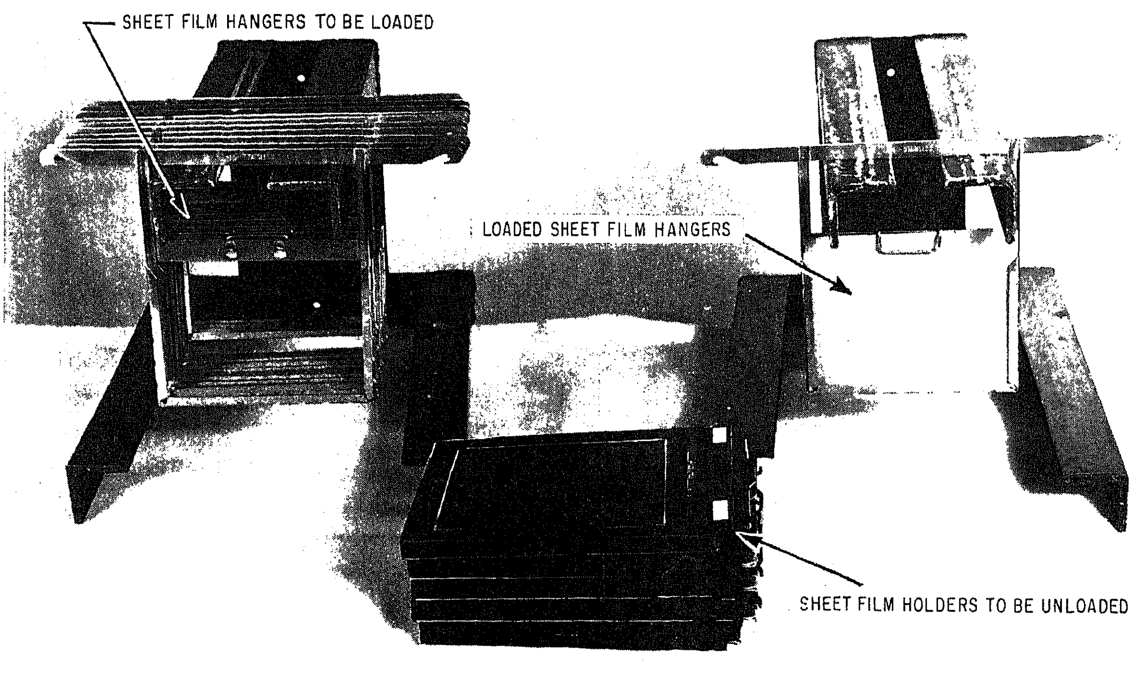
Tank development is the recommended method for hand processing of orthochromatic and panchromatic sheet film. The solutions and the tanks are deep enough to completely cover the films in the vertical position. The films are supported individually in the tanks by the film hangers. Films supported in this way are much less subject to damage. The solutions last longer when used in tanks, and process many more films than when they are used in trays.

Tank development for sheet film requires tanks to hold the solutions, and racks, reels, or hangers to support the films while in the solutions. The solutions used should have good keeping qualities, and they should be the type that can be renewed (replenished) by the addition of fresh solution or replenisher so the volume in the tanks can be maintained at the proper working level.

The minimum number of tanks that can be used is three: one each for developer, stop, and fixing bath. However, if a predevelopment rinse is used, four tanks are needed.

The tanks are arranged in the processing sink submerged in enough water to maintain the solutions at the prescribed processing temperature. Again the process is arranged so that work progresses from the left.

The film hangers are simply channeled frames suspended below a bar. The bar is long enough to reach across the tank and allow the frame to hang below the surface of the solutions. The frame has channel pieces on the bottom and both sides, and a hinged channel across its top. Each hanger holds from one to four films. The hangers accommodate standard film sizes such as 4×5, 8×10, etc. After the films are loaded into the



Sheet film hangers for tank development.

iangers, they may be carried through the entire process without being touched by the hands.

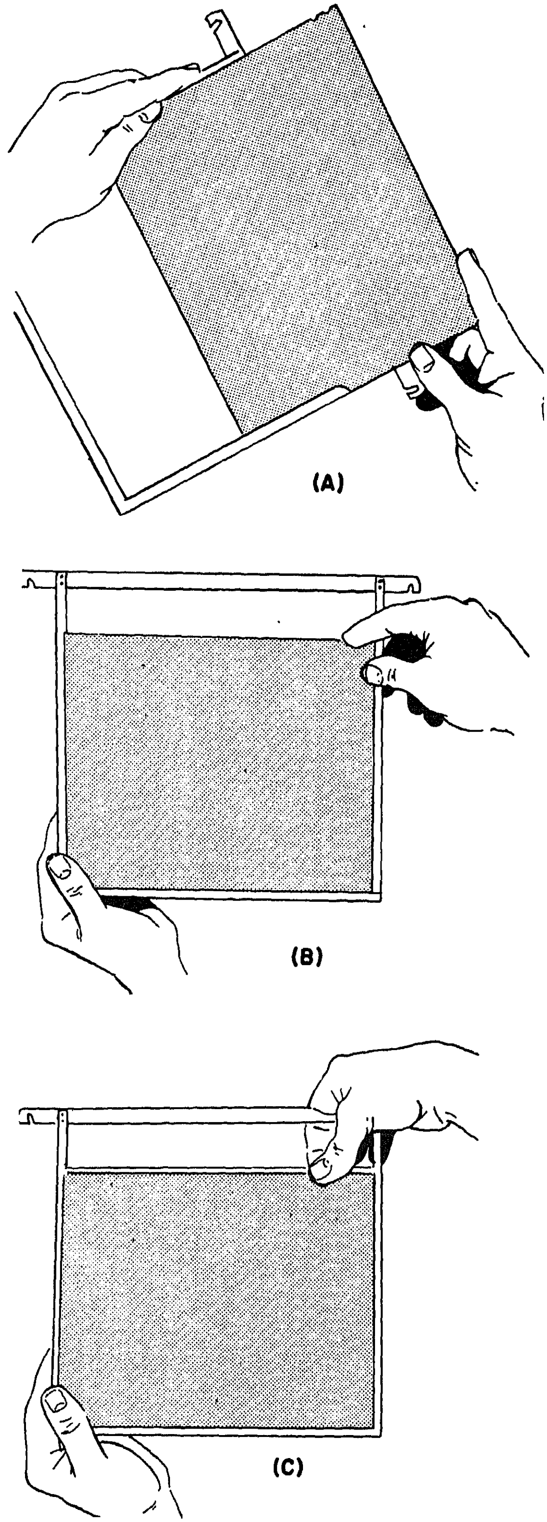
The darkroom should be checked using the teps common to all film processing as explained earlier in this chapter. After you check the olutions and their arrangement, check the emperature of the solutions, and check the afelights. Then arrange an adequate supply of lean, dry, empty film hangers on a rack, and an mpty rack to hold the loaded film hangers. If he darkroom is not equipped with racks to hold he film hangers, clean, dry tanks can be used to iold both unloaded and loaded hangers. Set the imer, place the exposed film holders between the mpty film hangers and the rack or tank that is ised to hold the loaded hangers, and turn out the ights.

To load a sheet film hanger, remove one of he sheet films from its *holder*. Take a *hanger* in one hand and place the thumb at one end of the iinged channel. Push the hinged channel up and ack with the thumb until the film can be slid long the inside of the end channels to the bottom of the frame. HANDLE THE FILM BY THE EDGES ONLY. Make sure the film is properly eated in the three channels of the hanger. When he film is properly seated in the side and bottom hannels, bring the top channel forward and down over its top edge. This encloses all four sides of he film in the channeled frame. The hanger hould be given a slight shake to ensure that the ilm is in place. Set the loaded hanger on the rack or in the empty tank provided to hold it.

The films should be loaded into the hangers with the emulsion side facing the operator. This prevents the top channel from scratching the emulsion as the film is slid into the frame. Load he other films to be developed in the same nanner. However, do not load more hangers than an be handled conveniently in the tanks at one ime.

When the hangers are loaded, lift all of them by their crossbars and lower them into the predevelopment water rinse, if one is being used. They should be lowered into the tank until the ianger crossbars rest on top of the tank. The predevelopment water rinse is optional when using he tank method of development, but the water inse has the following advantages:

- The air bubbles which usually occur when dry film is immersed in a solution can be removed



Loading a sheet film hanger.

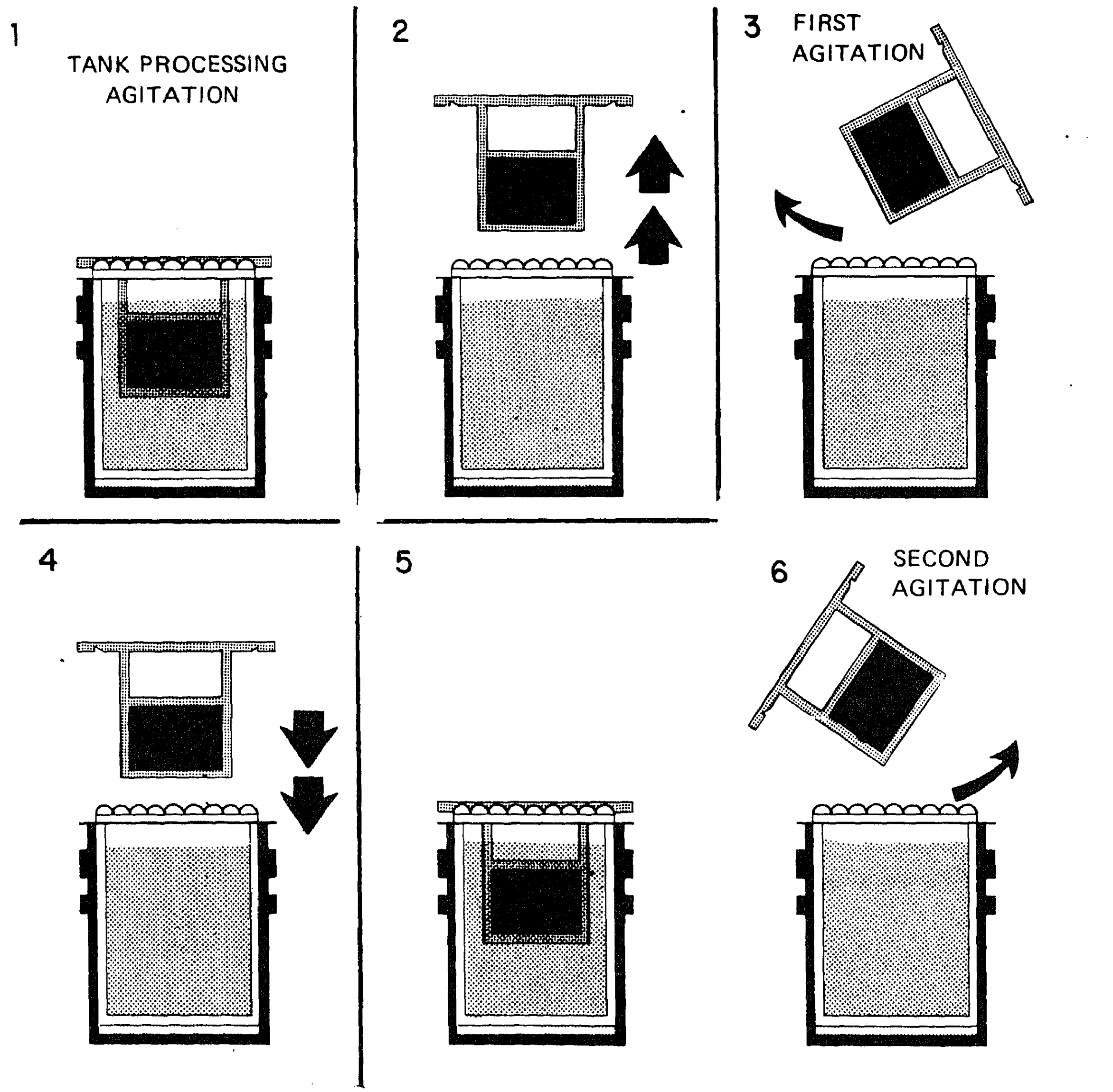
without any harmful effect in the predevelopment water rinse.

● When the water-softened emulsion is placed in the developer, the action of the solution begins uniformly over the entire emulsion. Thus, uneven or streaky development is avoided.

● The predevelopment water rinse removes the antihalation backing dye (a coating on the back of a film base that absorbs light which has passed through the emulsion and base, to prevent it from reflecting back into the emulsion) which interferes with the action of some developers.

● The predevelopment water rinse brings the temperature of the film and the hangers to the processing temperature. This is very important for maintaining constant temperatures in all of the processing solutions.

The predevelopment water rinse is given by immersing the loaded hangers in a tank of water and agitating them for about 2 minutes. The



temperature of the water should be the same as that of the other processing solutions. The loaded hangers are then lifted out of the water, drained, and processed in the usual manner.

Immerse the hangers in the developer slowly and smoothly to avoid splashing or the formation of air bells. Air bubbles usually result when films are immersed rapidly, especially if the predevelopment water rinse is not used. All the hangers should be immersed simultaneously to assure uniform agitation and development.

Strike the hangers sharply against the sides of the tank several times to dislodge any air bubbles that may have formed. Start the timer and leave the hangers undisturbed for approximately 1 minute. After the first minute of development, agitation should be at regular intervals and by a fixed schedule.

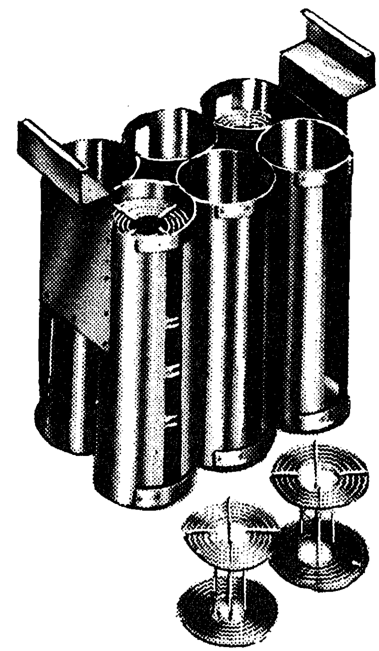
The processing tank usually has space enough for several additional hangers. However, this space is needed for proper agitation of the film hangers. Agitation may be accomplished by pushing the hangers slowly back and forth from one end of the tank to the other, or by lifting them out of the tank, draining them momentarily from a different corner each time, and replacing them in the solution. Hangers should not be agitated too vigorously from side to side. This forces the developer through the holes in the hangers at high speed, causing developing trails near the holes. The objective is to assure an even flow of fresh solution over the surfaces of the films according to a fixed schedule.

About 10 seconds before the completion of the developing time, lift all of the hangers out of the solution, let them drain for 10 seconds, then lower them into the stop bath. Shift them several times in the stop bath, drain them, lower them into the fixing bath, and agitate them constantly for 2 or 3 minutes.

The fixing and the washing requirements are the same as described previously in this chapter. When the washing is completed, place the film hangers and film into a wetting agent, then remove each film from its hanger and hang it up to dry.

If the films are dried in the hangers, there will be a number of drying marks along the edges of the film, thus reducing the actual usable size of the negative image. It is better to suspend each film individually from a line, with a film clip, and to dry the hangers, *after washing them in hot water*, without films in them.

With suitable racks to hold the reels, rollfilm also can be processed in sheet film tanks.



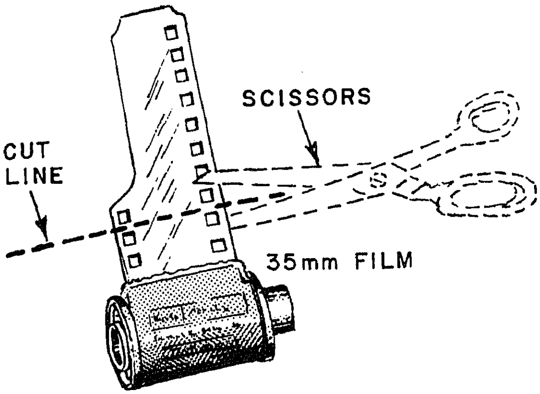
Rollfilm reel processing rack.

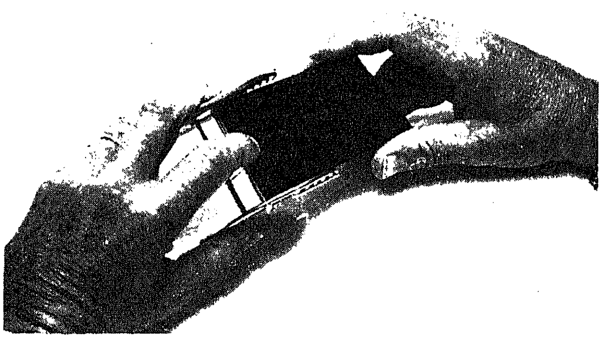
TANK DEVELOPING ROLLFILM

The most convenient and reliable way to hand process rollfilm is in a small rollfilm tank. The design, detail, and construction of various tanks and reels differ somewhat among the various manufacturers' models, resulting in differences in loading and use. Generally, the basic unit used in Navy photo labs consists of a stainless steel, center feed, spiraled reel to hold the film; a tank with a lighttight cover; and a filler cap. Each reel is constructed for a specific size roll of film. For example, 35mm, 120, 220, etc. The tank top permits pouring the chemicals in and out of the tank under white light conditions. The tanks come in sizes to hold from one 35mm reel to as many as eight 35mm reels or five 120 reels.

The proper loading of the film reel *in total darkness* is one of the most important steps and a challenge to the novice darkroom worker.

We are going to describe three ways of loading a center feed spiral reel. You should practice each method, both in white light and in total darkness, then select the method which is most comfortable for you and perfect that method. Although all three methods are similar, there are differences which may make one method easier for you. However, before beginning any of these methods, make sure that both the reel and your hands are clean and dry.



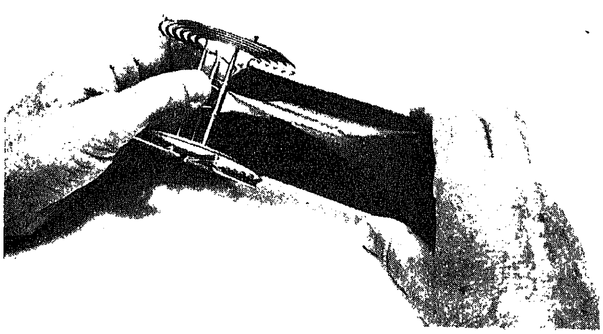


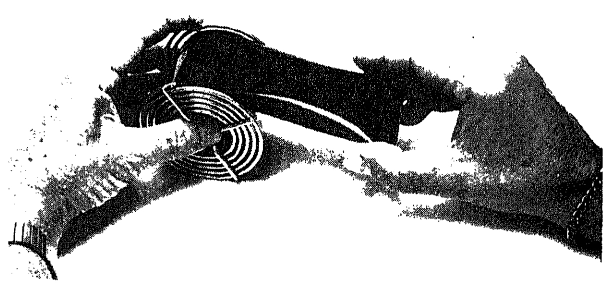
● First Method—Remove the film from the cassette (35mm) or separate it from the paper backing (120 or 220). The film must be handled by its edges only, in order to prevent scratches and fingerprints. (When you work with 35mm film, the tongue of the leader must be cut off to make a square end prior to loading the reel.)

Next, attach or hold the film to the core (center) of the reel so that it is bent slightly concave to clear the edges of the spiral. The film emulsion must face in, or toward the reel center. The tension on the film should be firm enough to prevent the film from skipping the spiral grooves, but not firm enough to cause it to overlap or fall into the same groove twice.

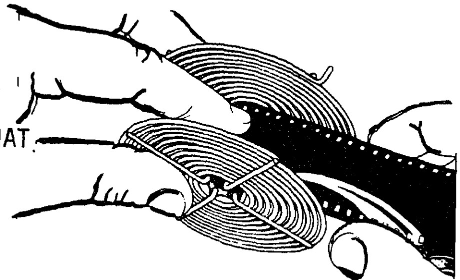
Turn the reel while applying a gentle pressure with the thumb and forefinger on the film edges. This pressure will produce a slight curl in the film and allow it to pass into the edges of the reel. As you continue to turn the reel, the film will straighten out and fit into the grooved spaces in the reel. Apply enough tension to the film so that it will not skip grooves. However, too much tension can cause the film to overlap into the reel.

● Second Method—Prepare the film as before. Hold the reel to be loaded on a clean working surface in the left hand, with ends of the wire spiral at the top, pointing toward the right. If you are left-handed, hold the reel in your right hand, with the ends of the spiral wires at the top, pointing toward the left.

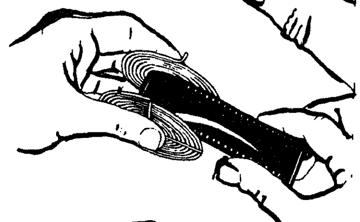




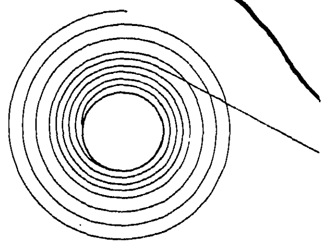
HOLD THE REEL SO THAT ITS GROOVES RUN IN THE SAME DIRECTION AS THE FILM. IN DARKNESS OPEN THE FILM CONTAINER AND ATTACH THE END OF THE FILM TO THE REEL CLIP SO THAT IT FEEDS IN STRAIGHT AND PARALLEL TO THE REEL GROOVES.



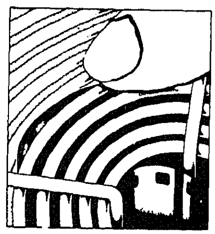
BOW THE FILM, BY GENTLY PRESSING ITS EDGES, SO THAT IT FEEDS SMOOTHLY ON TO THE REEL; BE CAREFUL TO AVOID SHARP KINKING.

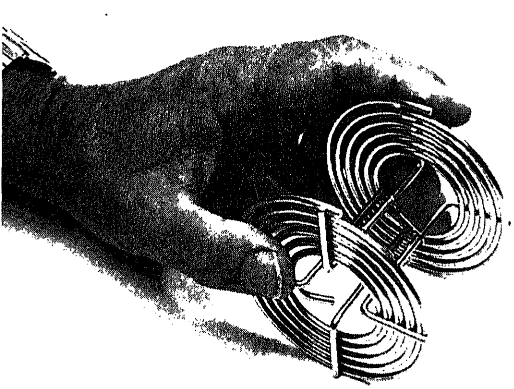


KEEPING THE FILM BOWED, ROTATE THE REEL WITH YOUR OTHER HAND, MAKING SURE THAT THE FILM DOES NOT TOUCH ITSELF. THE FILM SHOULD BE DRAWN INTO THE SPIRAL CHANNEL. IF IT JAMS OR FEELS BUCKLED UNWIND A TURN OR SO AND TRY AGAIN.



AT THE END OF THE FILM, CUT OR TEAR OFF THE SPOOL AND TUCK IN THE END OF THE FILM. RUN YOUR FINGERS AROUND THE OUTSIDE OF THE REEL TO FEEL IF THE FILM HAS BUCKLED DURING LOADING. IF ANY PART OF THE FILM IS PROTRUDING, THEN IT SHOULD BE UNWOUND AND RE-LOADED.



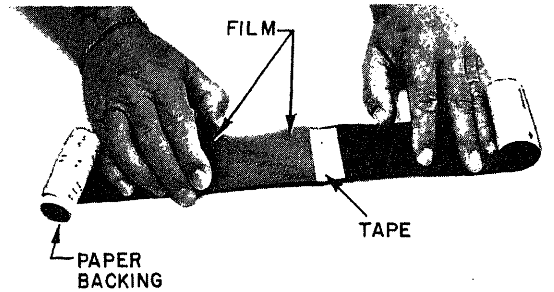


Hold the film by its edges in your right hand and bow it between your thumb and forefinger. With your left index finger or thumb, depress the grip clip and gently push the end of the film into the core of the reel. If the reel does not have a grip clip, insert the film end about one-fourth to one-half inch into the reel core and hold it there with your left index finger. Remember to always load the reel with the film emulsion facing in, or toward, the reel core. Be sure the film is held straight at the reel center.

Now turn the reel smoothly counterclockwise with your left hand, and guide the film into the spiral grooves with the thumb and forefinger of your right hand.

● Third Method—Slowly unwind the paper backing from the film until you feel the film with your finger. Do not completely unwind the paper

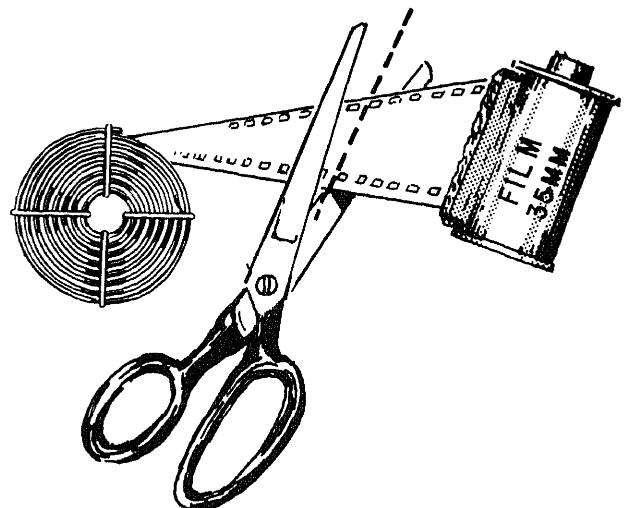
backing from the film. In the case of 35mm film, open the cassette and remove the film. Do not allow it to unroll. Cut the tongue off and insert the film back into the open cassette with about 3 inches of film sticking out of the lighttight slit.



Hold the reel to be loaded in your left hand, with the spiral wire ends at the top and pointing toward the right. Allow about 3 more inches of the paper backing to unroll. Bow the film and place it straight into the reel core. Smoothly and slowly turn the reel counterclockwise, guiding the film onto the reel. Allow the paper backing to unwind as the film is wound onto the reel.

When all but about 3 inches of the film is on the reel you will feel the end of the film taped to the paper backing. With 35mm film in a cassette, the film will stop unrolling from the cassette when the end is reached.

When you feel the tape or the end of the film is about 3 inches from the reel, carefully separate the film from the paper backing or cut the 35mm film right next to the cassette, being careful not to pull the film from the reel. Finish loading the reel.

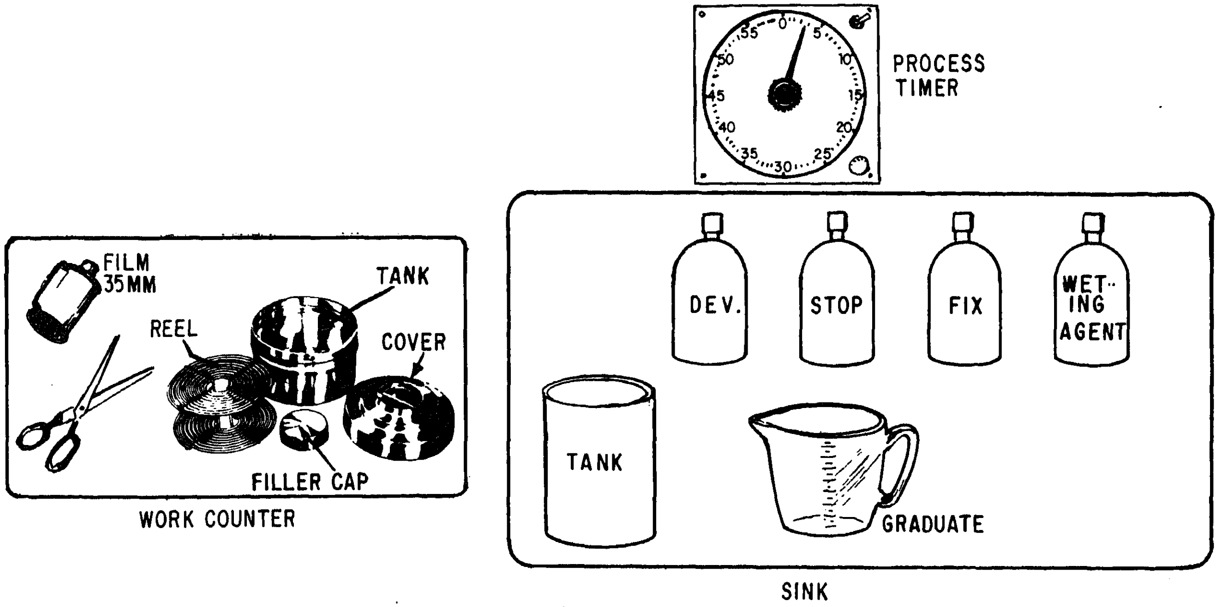


220 rollfilm does not have a paper backing the full length of the film as does 120 film. The paper backing on 220 film serves as a leader and tailer which are taped to their respective ends of the film. Therefore, when you use the third method described above, the paper trailer is removed from the film before loading of the reel can begin.

Before you attempt to process film using a reel, you should practice loading by using a roll of practice film in white light, then repeating the procedure in total darkness until you can do it with your "eyes closed," so to speak. Once you have the reel or reels loaded properly, you can think about processing.

When a rollfilm tank is used to process fewer rolls of film than the tank is capable of holding, the extra space in the tank should be taken up with enough empty reels to fill the tank. The empty reels should go into the tank on top of the reels containing film. Solutions, when poured into the tank, should completely cover ALL the reels in the tank.

When processing with a rollfilm tank which has provision for adding or dumping the chemicals without removing the cover, only one tank is required as the various solutions; predevelopment rinse, developer, stop bath, etc.; are poured out of and into the tank through the tank cover during processing. This can be done in white light. The chemicals, in their respective containers, should be arranged in the darkroom sink from left to right; developer, stop bath, etc.; and brought to the correct processing temperature in a tempered water bath.



Arrangement of equipment for processing rollfilm in rollfilm tank and reel.

A clean, dry area should be provided on the work counter for loading the film onto the reels.

When processing rollfilm with a paper backing such as 120 size film, etc., the paper tape sealing the exposed roll should not be broken until the lights have been turned out. Also, for 35mm film, the cassette should not be opened until the lights have been turned out. If a short length of film is left protruding from the 35mm cassette when the film is rewound, it is not necessary to open the cassette to remove the film. The leader or loading tab on 35mm film can be cut off square in the light to facilitate loading the spiral reel.

When the darkroom has been prepared and the solutions are at the specified temperature, fill the rollfilm tank with clean water from the faucet. This is the predevelopment rinse and should be at the specified processing temperature. Do not use the water in the sink for the predevelopment rinse. The water in the sink is probably contaminated.

Place the tank filled with predevelopment rinse in the sink. Dry your hands and turn out the lights. You are now ready to begin:

1. Load the reel or reels with the film to be processed.

2. Place the loaded reels into the tank of predevelopment rinse. If the loaded reels do not come to the top of the tank, add empty reels to take up the space. Place the cover and cap on the tank. The lights may now be turned back on. Once the lights are on and before the film is fixed, be careful not to remove the tank cover or the film will be exposed to light and ruined.

3. Hold the tank in one hand so that the cover and cap will not fall off, then lift the tank out of the sink and strike it once or twice on the edge of the sink to dislodge any air bubbles which may have formed on the film. Agitate the film in the predevelopment rinse for about 1/2 to 1 minute.

4. Remove the *cap* from the tank cover, and while holding the cover on, pour the predevelopment rinse from the tank. The predevelopment rinse can be poured right into the sink of water.

5. Hold the tank in one hand and tilt it slightly; pour the developer directly from the bottle or graduate into the tank through the light trap pouring hole. As the developer nears the top of the tank, hold the tank level or set it in the sink. Fill the tank to just overflowing. This step should take about 10 to 20 seconds, depending on the tank size.

6. Once the tank is full, immediately start the timer, replace the cap and strike the tank on the edge of the sink once or twice to dislodge any air bubbles. Now agitate the film by turning the tank slowly end for end and back one time and place the tank in the sink on its bottom (cover up). This agitation should take about 5 seconds.

7. Once every minute, agitate the film for 5 seconds by slowly turning the tank end for end. After each agitation period place the tank back in the sink. If the tank is held during the entire developing period, the heat from your hands may heat the developer and produce unpredictable results.

8. When only 10 seconds of developing time remain, remove the *cap* from the tank cover. Immediately start to pour the developer out of the tank through the light trap pouring hole, either back into the bottle from which it came or into the sink. This step should take about 10 seconds to complete.

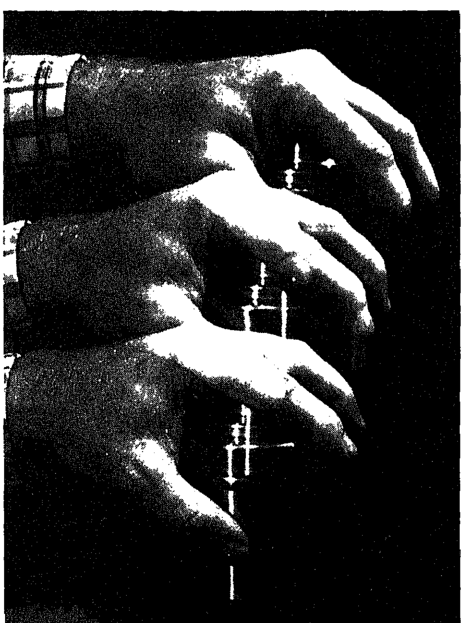
9. When the developer has been emptied from the tank, fill the tank to overflowing with stop bath. The stop bath must be poured into the tank through the light trap pouring hole in the tank cover. Replace the cover cap. Agitate the film in the stop bath for about 10 seconds using the end-for-end method.

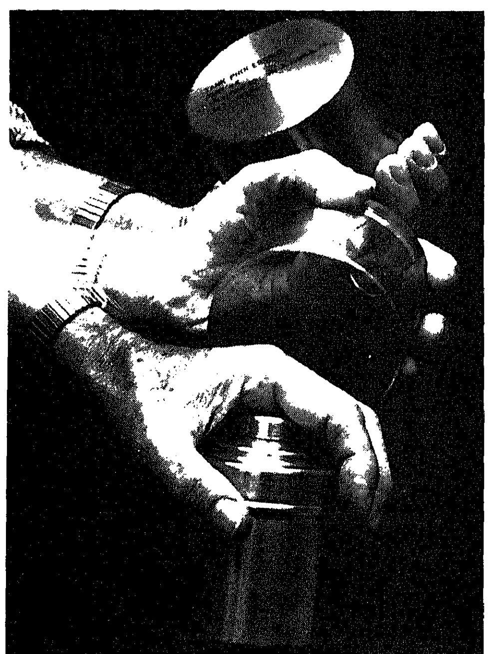
10. When the stop bath portion of the process is complete, pour the stop bath into the sink, through the light trap hole in the tank cover.

11. With the tank cover still in place, pour fixer into the tank and replace the cover cap. Dislodge air bubbles; set the timer to the required fixing time. Start the timer and agitate the film, fixing it for the prescribed length of time using the same agitation as previously.

12. When the prescribed fixing time has elapsed, remove the tank cover and pour the fixer from the tank back into the bottle from which it came. Do not pour the fixer into the sink. It is to be saved for silver recovery.

13. The film can be washed either in the tank or in a rollfilm washer. If the tank is used, insert a hose down through the center of the reels until it is about one-half inch from the bottom of the tank. Adjust the water (at the same temperature the film was processed) so a steady overflow is created. Wash the film for about 20 minutes. When you use a rapid rollfilm washer, again, adjust the water temperature and place the reels





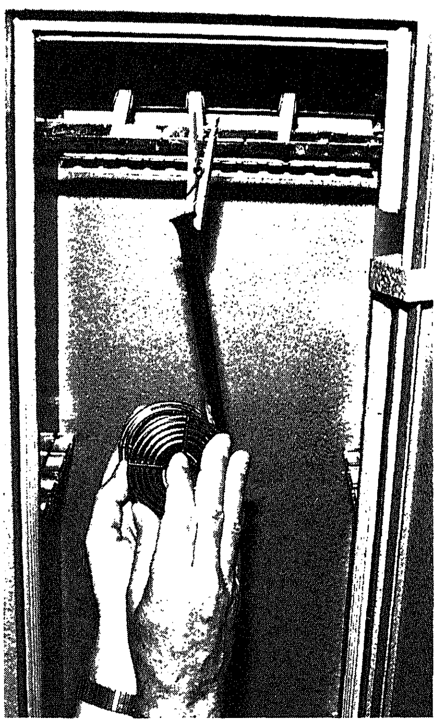
containing the processed film into the washer. Adjust the waterflow rate until the reels start to turn. When the reels start to turn, reduce the waterflow rate until the reels stop turning. Set the timer and wash the film for about 5 minutes.

14. While the film is washing, rinse the processing tank, tank cover, and cap with clean water. Fill the tank with water (check the temperature) and add the wetting agent. After the film has been washed, place the film, still on the reels, into the wetting agent solution. Replace the tank cover and cap and agitate the film in the wetting solution very S-L-O-W-L-Y for 1 minute.

15. After 1 minute in the wetting solution, remove the loaded film reels from the tank. (Do not save the wetting solution.)

16. To dry the film, attach the end of the film to a film clip in the drying cabinet. Let the film unwind from the reel as you slowly lower the reel.

When the film is unwound, depress the grip clip (if the reel has one) or remove the film from the core of the reel. Attach a second film clip to the lower end of the film. Close the drying cabinet door and dry the film.



Cleaning Up

After processing any film, the darkroom and all equipment must be immediately cleaned up. Thoroughly rinse all processing equipment; tanks, reels, hangers, thermometers, funnels, etc., in clean warm water. Place the clean equipment where it can dry before it is needed for the next processing run. *Keep it shipshape.*

Wipe down all workbench areas and the sink. If the floor is splashed or wet, mop up all chemicals and water. In general, always leave the darkroom spotlessly clean and in good order—ready for the next processing run.

PROCESSING QUALITY

The development required to produce any particular film processing quality varies with different developers and film combinations, time and temperature of the process, agitation, the film exposure, and the skill of the darkroom worker. A good, high-quality film, and in particular a negative, is one which is free from all processing faults including scratches and dirt, etc.

When processing negative-type black and white films, the objective, normally, is to produce a negative which is as fault free as possible and is "normal." Normal is a rather vague term; however, a normal negative is generally considered to be one that will yield a pleasing print or reproduction of the original scene when printed without a printing filter or with a No. 2 printing filter.

If a negative-type black and white film is *properly* exposed and *developed normally*, it will be a normal negative. However, when a negative varies from normal, you should be able to determine what conditions caused the deviation.

A negative has several *basic* characteristics which sould be considered when subjectively evaluating its quality. These *basic* characteristics are:

- General negative density or opacity to light.
- Image highlights or areas of greatest density.
- The shadows or areas of least density.

- Contrast, or the differences between highlight density and shadow density.

- Tonal gradation, or the range of grays, between the highlights and the shadows.

- Graininess, or the appearance of the silver grains in a negative which have clumped together. The size of the clumps determines the degree of graininess in the processed material.

All the basic characteristics of a negative are affected to some extent by a combination of exposure and development. By studying these characteristics, the cause of an error in a negative or of poor quality can usually be determined.

DENSITY

Density determines how much of the incident light falling upon a negative passes through the image. If very little silver is present in the negative, the image appears thin (transparent), and it is said to have a low density. If there is a large amount of silver present, very little light passes through the image, and the negative is said to have a high density, or it may be called a heavy or even a dense negative.

A low density, thin negative can be caused by underexposure or underdevelopment or by a combination of the two. A heavy or dense negative is the result of either overexposure or overdevelopment or a combination of the two.

HIGHLIGHTS

The highlights or dark areas of a negative for most purposes should not lack detail. If detail is lacking because the highlights are too dark, the highlights are said to be too dense or blocked up. Excessive highlight density is caused by overexposure and/or overdevelopment. If, on the other hand, the highlights are too thin, the highlights and the shadow areas will lack detail. Thin highlights are caused by underexposure and/or underdevelopment.

This may seem like a repetition of the previous discussion on density. However, a negative could and may have *overall* good density except in the highlight areas. This situation may result when the exposure latitude is not great enough for the scene brightness range.

SHADOWS

The shadows, or the more clear areas of the negative, should also contain image detail. If these areas are so thin and weak that they are transparent or nearly so, the shadow areas are said to be lacking in detail.

Loss of shadow detail can be caused by underexposure and/or underdevelopment. And, again, the negative may have overall good density. This may also be the result of the exposure latitude of the film not being sufficient for the scene brightness range.

The need for detail in both the highlights and the shadows for photographs of most subjects cannot be stressed too strongly. One is just as important as the other in the production of good photographs.

CONTRAST

Contrast is the difference in density between the highlights and the shadows in a negative. If this difference is great, the negative is said to be contrasty. If the density difference is small, the negative is said to be flat, or lacking in contrast.

For a negative to have normal contrast, the density differences between the highlight and shadow areas of the negative must be proportional to the reflective brightness range of the subject photographed.

A contrasty negative usually is the result of overdevelopment, but also may be caused by a high scene lighting ratio, or a contrasty original scene. A flat negative on the other hand may be caused, primarily, by underdevelopment, or by a low light ratio, or the original scene having a low contrast.

TONAL GRADATION

Photographers often concentrate on the density and detail of highlights and shadows when they should actually be considering the most important, or middle tones of the negative. Middle tones are the various tones of gray between the highlights and the shadows; that is, the densities which are not highlights or shadows are

termed middle tones. They are also called halftones and intermediate tones. The middle tones vary with the type of film and the subject contrast. A negative should have a range of middle tone densities which correspond proportionately to the middle reflective brightness of the subject photographed. A panchromatic negative which lacks appropriate midtones is probably contrasty or flat.

GRAININESS

Inasmuch as photographic images are made up of fine silver grains, the images may appear "grainy" or exhibit graininess.

All negatives show graininess to some extent. The most important factors affecting negative graininess are:

- The composition of the emulsion, or the inherent graininess of the emulsion. That is to say, the size of the grains used to produce the emulsion.

- The type of developer used. When fine grain is desired, a fine grain developer with the appropriate film should be used.

- The extent of development. Overdevelopment is a major cause of excessive graininess.

- Exposure or negative density. Overexposure is another key contributor to graininess. As negative density increases, so does graininess.

- Image sharpness. The sharper the film image, the greater the image detail and the less apparent the graininess.

Appearance of negative graininess.

Negative defects; their appearance, cause, and remedy

Defect	Appearance	Cause	Remedy
Abrasion marks or streaks	Fine black lines, usually resembling pencil scratches and running in the same direction.	Friction on emulsion caused by improper handling or storage.	Great care should be taken in storage of film. Boxes containing film should be stored on end so that no pressure is exerted on the surface of the emulsion. Care should also be taken not to rub or drag sensitized material over a rough surface.
Air bubbles	An air bubble occurring during development shows as a small transparent spot. Sometimes minute dark streaks lead from spot. When the negative is rocked in a tray, streaks project from each side of spot in the direction the tray was rocked. If	Transparent spots occurring in the developer are caused by bubbles of air on the surface of the emulsion. These prevent developer from coming into contact with the emulsion. Darkened streaks are the result of excess oxidation of	Immerse film carefully and thoroughly in developing and fixing solutions. Move film during development and fixation to break up and prevent air bells. Water always contains some air and when there is a rise in temperature, air is expelled and gathers in

Negative defects; their appearance, cause, and remedy—Continued

Defect	Appearance	Cause	Remedy
	a cross with a transparent spot in the center. In tank development, dark streaks usually form at the lower edge of the transparent spot. In the fixing bath they show as small, round, dark spots.	which occur in the fixing bath are caused by a pocket of air holding the fixer away from the emulsion and allowing a slight continuation of development.	and also on the surface of the film during preliminary stages of development.
Blisters	They resemble the familiar ones which arise from slight burns on human skin.	Liquid or gas formed between the emulsion and film support when the solution has become too warm and has loosened the gelatin from its support. Also produced by developer and fixer being too strongly concentrated. Changing film from one bath to the next may cause formulation of gas between the emulsion and support. Frequently caused by insufficient rinse after development, and placing the film directly into fixer having a strong acid content. Another common cause is allowing water from a faucet to flow directly on the emulsion.	Description of the causes of blisters indicates the manner in which defects may be avoided.
Brown spots	Small brown or sepia colored areas or spots on the negative.	Produced by oxidized developer or by fine particles of chemicals settling on the film prior to development. May also occur during washing, from rust or other impurities in the water.	Avoid exhausted or oxidized developer. Do not use developing room for mixing chemicals. Filter the wash water.
Crystalline surface	Surface of the negative emulsion possesses a crystalline appearance suggesting frost on a window pane.	Insufficient washing after fixing. Hypo remains in the film, and crystallizes.	Use sufficient final washings.
Dark lines	These lines are divided into two distinct classes. The first class, those which run from dark areas to the more transparent areas of the negative, and	The first class is caused by insufficient agitation of the negative in tank development. Cause of the second class is thought to be of an electrolytic	For the first class, more frequent agitation during development. Remedy for this class aggravates the defect in the second class. Only known remedy is to

Negative defects; their appearance, cause, and remedy—Continued

Defect	Appearance	Cause	Remedy
	transparent areas to the darker areas. In both cases lines are wider, not as clean cut, and not nearly as parallel as abrasion marks.		times during the developing period, holding the hangers in a bunch, and allowing the corners of the hangers to rest on the edge of the developing tank for 10 to 15 seconds.
Fading tendency	Sepia or yellow colored stains or areas in negative.	Incomplete fixation or insufficient washing will cause fading. Remnants of the fixing bath left in the emulsion will continue its action, and in time this defect appears.	Properly fix and wash negatives completely. Final washing is as important as any other operation in film processing.
Fingermarks	Imprint of fingers shows up on negative.	Impressing wet or greasy fingers on the emulsion of film before or during development and fixation. If mark is merely an outline of the finger, it was caused by water or grease on the finger; if dark, it was caused by developer; and if transparent or light, it was caused by the fixing bath.	Keep hands clean and dry when handling film. Sometimes natural oil on fingertips causes grease marks. Handle film only by the edges. When fingers become wet with water or solutions, wash and DRY THOROUGHLY before attempting to handle film.
Fog (Aerial)	A slight veiling of the negative or parts of the negative.	Negative exposed to air during development. Occurs most frequently in freshly mixed developers.	
Fog (Dichroic)	Usually a fog of little density, consisting of finely divided particles of silver. When viewed by transmitted light it is pinkish; when viewed by reflected light, it appears reddish green.	Hypo or excessive amount of sulfite in the developer.	Easily removed by treating the negative in a weak solution of potassium permanganate. Further prevention is assured by using clean tanks for developer and fixer solutions.
Frilling	Edges of the gelatin become detached from the base. Detached edge of emulsion may either break off or fold over. When the latter happens, it is sometimes possible to partially remedy the damage by smoothing out the emulsion when the negative is placed to dry.	Careless handling; using solutions that are too warm; insufficient hardening of emulsion due to insufficient fixation; exhausted fixing bath or one containing insuffi- amount of hardener; and/or excessive washing. Frilling is usually caused by a combination of careless handling and any other mistake that will render the emulsion or film soft.	Handle film carefully and sparingly; use working solutions that are mixed correctly and are at the proper temperature. Wash film sufficiently, but never excessively.

Negative defects; their appearance, cause, and remedy—Continued

Defect	Appearance	Cause	Remedy
Gas bubbles	Minute pimples or blisters.	Develop by transferring the negative from strongly concentrated developer to strongly acid fixing bath without thoroughly rinsing after removing it from developer and before immersing in the fixing bath. In warm weather, gas bubbles may appear even when using solutions of normal strength, if rinsing between development and fixation has been insufficient.	Use a stop bath.
Pitmarks	Fine holes or pits in emulsion.	Excessive alum in fixing bath; sulfurous precipitation from fixing bath when negatives are fixed in a tray; and too rapid drying of film.	Proper fixing and drying.
Pinholes	Minute transparent spots.	Dust on film before exposure.	Proper handling of film.
Reticulation	Leatherlike graininess or wrinkling of the emulsion.	Too great a difference in the temperature of baths or between final wash water and the air in which the negative is dried. Gelatin may become badly swollen due to the temperature of a solution or wash water, and upon shrinking, contracts irregularly due to the metallic silver incorporated in the emulsion. Excessive softening of the emulsion followed by a strong hardening bath, or a alkaline treatment followed by strong acid.	Keep all solutions at uniform temperature. Reticulation effect may sometimes be removed by placing the negative in a 10-percent solution of formaldehyde for a few minutes and then drying rapidly with heat. Use ample ventilation in drying negatives treated in formaldehyde.
Streaks	Streaks and patches, as in the case of spots, may be dark, white, or transparent.	May be due to uneven development, by developer not flowing evenly over film, by not rocking the tray, or not moving the	Precautions to avoid streaks suggest themselves when the cause is traced. In many cases, they can be avoided by care in

Negative defects; their appearance, cause, and remedy

Defect	Appearance	Cause	Remedy
		film in the developer. May also be due to developer splashed on the film before development, a dirty tray or tank, fixer tray or tank used for developing, or a light fog. If the edges of the film are clear, trouble is in the camera; if edges are fogged, it is due to manipulation in the darkroom. Certain kinds of resinous woods and varnishes cause dark fog patches. White or transparent patches may be due to obstructions in the camera, which prevented light from acting on the film; a "resist" in the form of oil or grease, which prevented action of the developer; a splash of hypo, or film touched with hypo-soaked fingers before development. Hypo dissolves away some of the emulsion so that, on development, the portion touched appears lighter than the rest. Drying marks in the form of teardrops or white patches are caused by splashes of water on a dry negative or by leaving spots of water on the film before drying, especially if the film is dried in warm air.	operation and maintenance of equipment. When placing the negative to dry, blot excess moisture from both sides or use suitable wetting agent.

Effects of Exposure and Development Variations

The nine negatives reproduced here compare the effects of exposure and development variations. From the left they show the effects of development; from the top they show the effects of exposure. The center negative has been given both correct exposure and normal development and is a "normal" negative that will print without a filter or with a No. 2 filter.

Negatives 1, 4, and 7 have been underdeveloped, while 3, 6 and 9 have been overdeveloped.

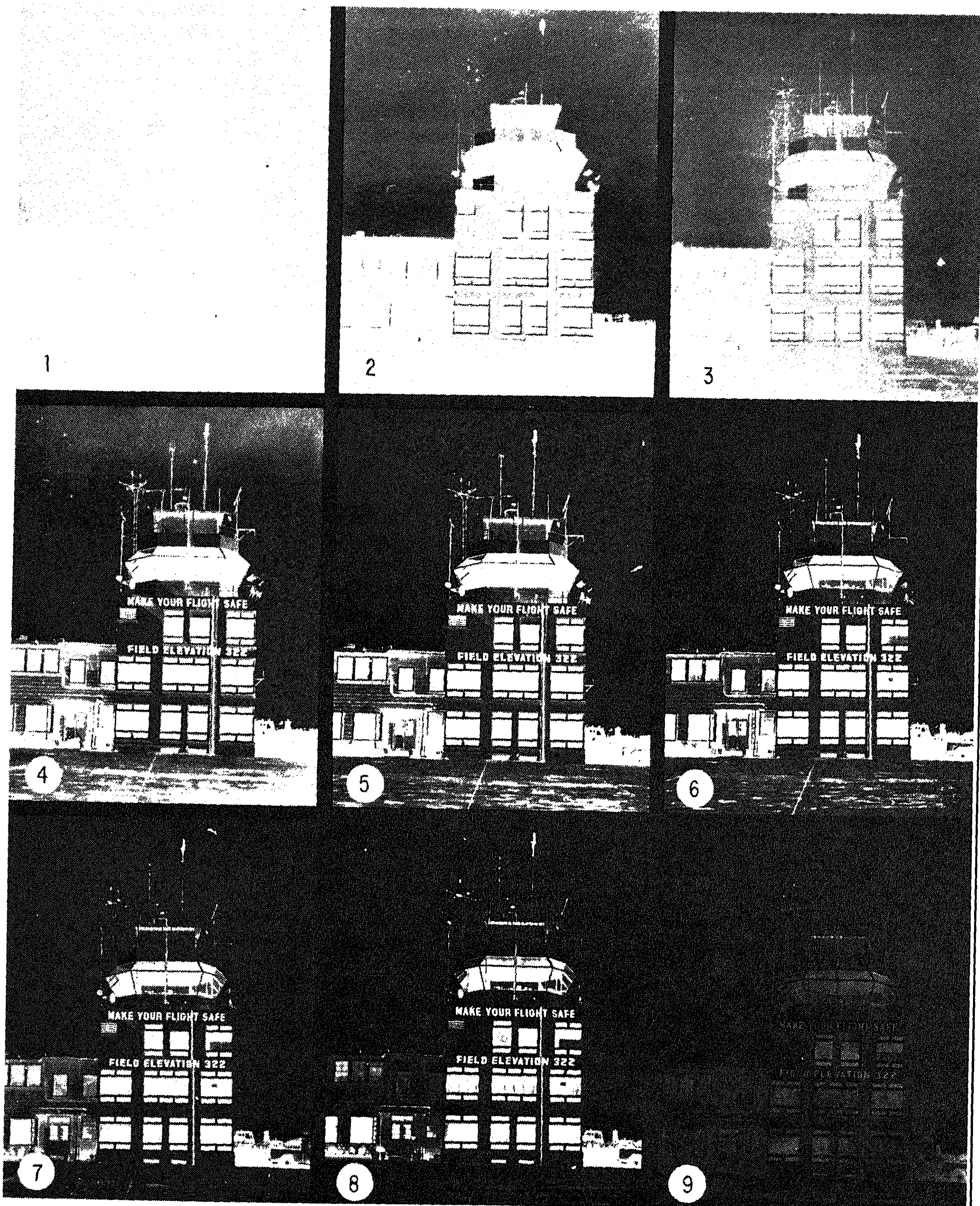
The negatives across the top—1, 2, and 3—are underexposed and lack detail in the shadow areas. Increasing development (No. 3) had no appreciable effect on the lack of shadow detail. Little can be done to improve negative quality when exposure is insufficient. Underexposure is identified by lack of shadow detail.

The negatives across the center—4, 5, and 6—were given correct exposure and all have sufficient shadow detail. However, No. 4 was underdeveloped and is flat or lacks adequate contrast. Negative No. 5 which received normal development has good shadow detail and good contrast. It is a "normal" negative. Negative No. 6, although having received correct exposure, was overdeveloped. This resulted in excessive highlight density with a loss of highlight detail, and excessive contrast. The highlight in both 6 and 9 is too dense.

Negatives 3, 6, and 9 are all overdeveloped. The correctly exposed negative, No. 6, is so dense that almost no detail is visible in the highlights. The highlights of the overexposed and overdeveloped negative, No. 9, are completely blocked up.

When a correctly exposed film is given normal development as in negative No. 5, the negative will have clearly defined detail in all parts of the image from the strongest highlights to the weakest shadows. The contrast will be satisfactory. It may not exactly reproduce the contrast of the original scene, but it has sufficient contrast to produce a pleasing reproduction.

When the film is overexposed and normally developed, as in No. 8, the highlights in the image show a loss of detail. Giving the overexposed film less than normal development may save some highlight detail, but it also reduces the contrast. If the overexposed film is overdeveloped, as No. 9 was, all highlight detail may be destroyed and the contrast may also be reduced.



Effects of exposure and development.

REVERSAL DEVELOPMENT

In the normal methods of hand processing black and white film, a negative is produced; from this negative a positive paper print is made. However, by the use of the reversal process, it is possible to produce a positive image directly on the black and white film.

In the reversal process, a negative image is first obtained by developing the original latent image. After leaving the developer, the *negative* image is dissolved or bleached out. The silver halides remaining are either exposed to light or chemically "exposed" (fogged). This is then followed by a second development which may be followed by fixing and washing.

Not all black and white films reverse well. Special reversal films have been produced by some manufacturers, and they provide instructions as well as reversal processing kits (packaged chemicals) for various films which are suitable for reversal processing.

COLOR PROCESSING

Color adds realism to photographs. At one time color was difficult to work with. It required special cameras and specialized films that could be processed only by the film's manufacturer. Now color materials have been improved to the point that color is far more popular than black and white. Color photography in the Navy is very important for research and development, slide briefings, documentation, displays, investigation, evidence, and medical photography, plus many other uses. In fact, it would not be surprising if, in the future, color photography almost completely replaces black and white photography in our Navy.

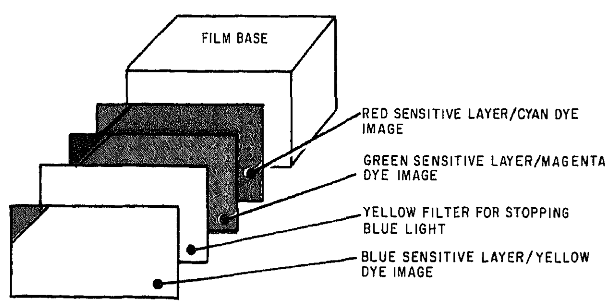
All modern color films have three emulsion layers on the film base. The top emulsion layer is sensitive to blue light only and reacts strongly to primary blue areas of the scene being photographed, and proportionally to areas of the scene reflecting some blue light. The second, or middle layer is sensitive to green light, and the bottom layer to red. The middle and bottom layers, however, are also sensitive to blue light, so a yellow filter between the top, blue sensitive and second or middle, green sensitive layers prevents blue light from reaching the second and third emulsion layers.

The sensitivity of each emulsion layer is due to its silver halides which can be developed to black metallic silver where they received light of their color sensitivity. The final color image is produced by dyes which form coupled to the black metallic image during processing. These dyes are in colors complementary to each layer's sensitivity. After processing, the top or blue sensitive layer contains a yellow dye image; the middle, green sensitive layer a magenta dye image; and the bottom, red sensitive emulsion a cyan image.

Primary colors affect one emulsion layer only, while complementary colors affect two layers. For example, the color cyan (a mixture of blue and green light) affects the blue and green sensitive layers. White light affects all three emulsion layers while black has no effect on any layer.

In a negative color film the dyes are coupled to the negative images produced by exposure to the primary colors. Therefore, the blue light image is dyed yellow, the green light image is dyed magenta, and the red light image is cyan. A cyan image is produced when the blue sensitive or top layer contains a yellow dye image and the middle or green sensitive layer contains a magenta dye image. The *dye images* in a processed color *negative* are complementary to the colors of the original scene. The color negative is a *halfway* stage to a color print.

A slide or color transparency film has dyes formed according to a "reversed" silver positive. For example, a yellow dye image forms in the top emulsion corresponding to an *absence* of blue in the original scene and subtracts blue light. A blue image is formed in the middle and bottom layers by magenta dye which subtracts green, and cyan which subtracts red, thus leaving blue. In a color transparency film the dyes subtractively produce a correct color positive image of the scene photographed.



The type of color process applied to a color film depends on whether the film is reversal (slide) or negative-type film. For slide film processing the first step is to develop the latent image in each emulsion layer to a black metallic negative, using a monochrome or first developer. This, like black and white negative processing, leaves undeveloped areas where the halides were not affected by the camera exposure, thus forming a potential positive image. In reversal color film, it is in these areas that the final color positive images are formed. After the first developer, the film is "fogged" (usually done chemically) so the undeveloped halides are themselves "exposed."

After fogging, the film is developed in a color developer which changes the fogged halides to black silver while at the same time the relevant cyan, magenta, and yellow dyes form in each emulsion layer, coupled to these same halides.

At this stage the film looks completely black because the now formed dyes are shielded by the developed silver. This black silver is removed by a process of bleach-fixing, leaving the dyes to form the image. After the film is washed it is treated briefly in a stabilizer to make the dyes more permanent.

The color negative process creates a negative color image corresponding to the image formed by exposure. There is no fogging stage. The first step in negative color film processing is color development. The exposed areas of each emulsion layer are developed to black silver. These areas are also where the coupled dyes are formed. Bleaching removes all the unwanted silver deposits and allows you to see the final complementary color negative image. Fixing, washing, and drying follow.

The cyan and magenta dye image layers formed by color processing absorb some light wavelengths they were intended to transmit. In the case of negative color film, these wavelengths of light would cause a color cast in the final print. However, to prevent this, the green and red sensitive emulsion layers of the film are given a yellowish and pinkish appearance, respectively, during manufacture. This is the cause of the overall orange cast or mask seen in a processed color negative.

COLOR FILM PROCESSING EQUIPMENT AND PROCEDURES

The hand processing of color film is basically the same as processing black and white film. The equipment used is the same, as are the mechanics of the process.

Color film processing chemicals are available for each type of color film to be processed, either in kit form or in individual solution packages. You should always follow the manufacturer's instructions when mixing and using color chemistry.

The temperature of each solution and the time the film is in each solution, as well as water rinses and washes, are *critical* to good color results. You should always follow the manufacturer's recommendations for timing and temperatures.

CHAPTER 4

BLACK AND WHITE PRINTING

In photography, printing is the term used to describe the process of making positive images from negatives (and in some instances from film positives). The most familiar example is the print made on a paper base. A photographic print is made by passing light through the negative onto a piece of paper which has been coated with a light sensitive photographic emulsion, very much like film.

There are two primary methods of making photographic prints: *contact printing* and *projection printing*. The principal difference in the two methods, contact and projection, is the method of exposing the paper. In contact printing, the paper is physically in contact with the negative, while in projection printing the paper is separated from the negative and the image of the negative is projected onto the paper by a lens. Because projection printing is usually used to produce an enlarged image, it is generally referred to as enlarging. Contact printing produces positive images which are the same size as the negative images. Enlarging produces positive images which are larger than the negative image—usually. However, because in projection printing, optics are used, the image formed on the paper can also be made smaller or the same size as the negative image.

The quality of the photograph can be varied during printing by the choice of printing material, exposure, and processing. In printing, *some* negative defects may be compensated for, thereby eliminating the reproduction of the defect in the print.

A well-planned, black and white print darkroom or print room should have at least the following material and equipment properly arranged so that the flow of work moves easily from one stage to another:

- A contact and/or projection printer (enlarger).
- A sink which is large enough to accommodate the largest trays normally used in the print room.
- Safelights.
- A set of print trays.
- A graduate.
- A thermometer.
- Print tongs.
- A wall clock with a sweep second hand.
- Hand towels.

Photographic printing papers are predominantly blue sensitive and may be processed under prescribed lighting conditions. Consult the data sheet packaged with the paper you will be using or the Photo Lab Index for the recommended safelight to use.

A minimum of three trays should be available for processing the prints. The trays should be arranged in the sink from left to right—one each for developer, stop bath, and fixing bath. The ideal setup is to have five trays—one each for developer, stop bath, first fixer, second fixer, and a water rinse. This setup provides a savings in chemicals and results in better fixing of prints.

The chemistry of development and fixing for prints is similar to, and serves the same purposes as film processing. When processing conditions are carefully controlled, the processing formulas and processing specifications recommended by manufacturers for their printing papers can be depended upon to yield excellent and consistent results.

The standard print developer used throughout the Navy is D-72. (See the Kodak section of the

Photo Lab Index.) D-72 is normally diluted 1:2 (1 part developer to 2 parts water) for most routine printing. The recommended developing times vary with the type of paper (emulsion). However, the developing time for printing papers generally ranges from about 70 to 140 seconds, when the developer is at a temperature of 68 °F. The useful capacity of D-72 developer is about 100 8 × 10 prints, or equivalent, per gallon when the dilution is 1:2.

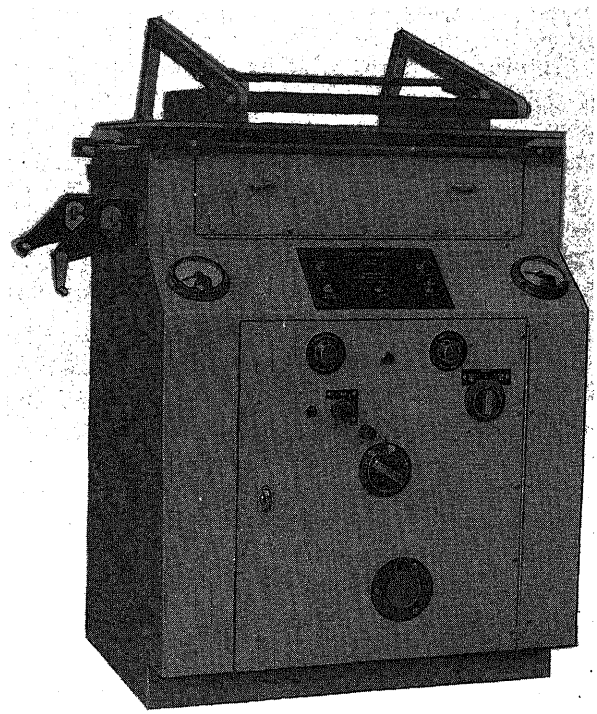
Any standard stop bath serves sufficiently. A stop bath may be used at all times, but it is especially necessary when processing a large number of prints. Furthermore, the use of a stop bath after development prolongs the life of the fixing bath. If no acid is available for a stop bath, a water rinse, at least, should be used after the developer.

A standard fixing bath, Kodak Fixer, or a rapid fixer should be used to fix the prints. Consult the Photo Lab Index for the various prepared chemicals available for fixing prints. Follow the manufacturer's instructions when fixing prints because there are injurious effects in overfixation as well as underfixation. Overfixation tends to produce thinning or bleaching of the photographic image. Underfixation will cause the image to darken with time. The use of two fixing baths (covered later in this chapter) is recommended for thorough fixation when many prints are processed daily.

In this chapter we will be discussing the procedures and techniques for producing black and white positive paper prints from black and white negatives. However, keep in mind that the procedures and techniques given here are basically the same for printing color negatives and positives to produce color prints as well as making duplicate black and white film positives.

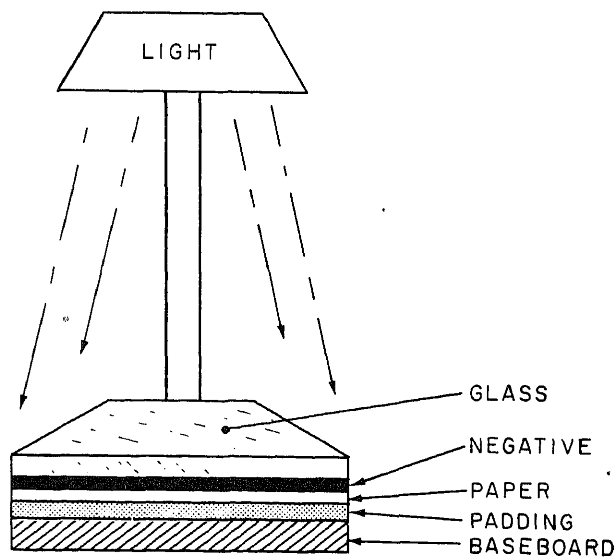
CONTACT PRINTING

A contact print is produced by exposing a sheet of photographic printing paper through a negative with the paper's emulsion and the emulsion side of the negative in absolute and uniform contact. Light is directed through the negative which controls the amount of light transmitted to the paper. The dense areas of the negative pass less light than do the more clear or less dense areas. The image densities formed (after development) in the paper's emulsion make it a positive print that represents the tonal values of the subject photographed. Furthermore, since the paper is in direct contact with the negative, a print which has exactly the same image size as the negative is produced. When making a print from a negative by this method, only a 1:1 ratio is obtainable; but contact printing is generally a



Courtesy Miller-Holzwarth, Inc.

Contact printer.



more rapid means of making prints than enlarging.

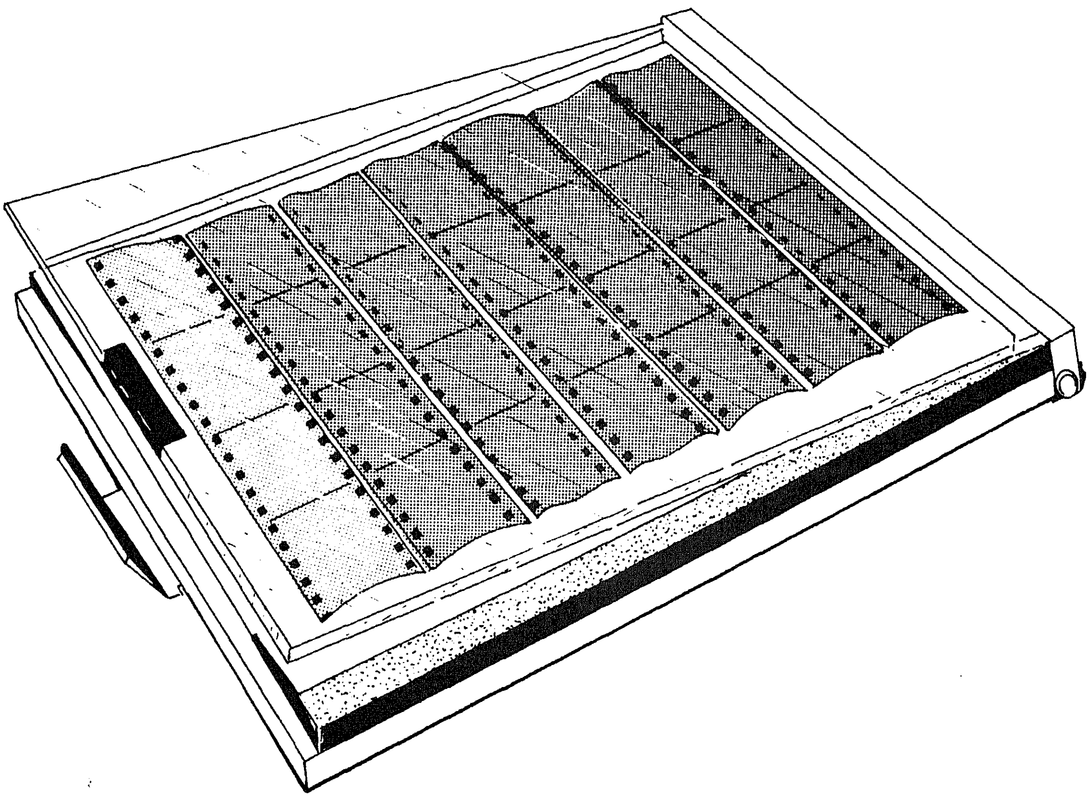
The quality of contact prints can usually surpass that of enlargements because there is no scattering of the image-forming light, as is the case with projection printing. However, with the ever-increasing use of small film format sizes and the fact that only same size prints can be made by contacting, enlarging has pretty much replaced contact printing in our Navy except for making proof prints.

CONTACT PRINTERS

Contact printing is the quickest, simplest, and most economical method of producing photographic prints. For making proof prints and small volume printing, a "contact printer" need be nothing more than a sheet of glass, a light source, and some sort of padding. For large volume and fine printing control, a specially designed and constructed contact printer is used.

Glass and Pad

For making contact proof prints and the occasional contact print job, a glass and a supporting pad are all that are necessary. "Contact printers" consisting of a glass hinged to a metal frame and a pad assembly are available and generally known as *proof printers*. If such a device is not available or is not large enough for the negatives to be contact printed, a piece of 1/4 inch plate glass and some sort of soft padding such as a rubber typewriter pad can be used. Quarter-inch plate glass is heavy enough to keep the negatives and paper flat and in contact during exposure. The glass must be free of flaws, scratches, bubbles, and dirt. For color contact printing, the glass should be *water white* or *crystal* grade; otherwise filtration may be required to overcome the color tint of the glass. The edges of the glass should be beveled and the corners slightly rounded or the edges and corners can be taped to prevent cuts when the glass is handled.



A proof printer presses strips of negatives against a sheet of photographic paper to facilitate exposing proof sheets.

The pad should be at least as large as the glass. The pad provides a cushioned or resilient surface to press the paper and negative together under pressure from the glass.

To use either the proof printer or the glass and pad to make contact prints, the printing paper is placed emulsion up on the pad material, the negative is placed emulsion down on the paper, the glass is positioned on the top, and the exposing light is turned on. This is, of course, done in the darkroom under suitable safelight illumination.

Adequate pressure must be kept on the negative and print paper so their entire surfaces are in contact during the exposure. Any separation between the negative and the paper will result in unsharpness in the image at that point.

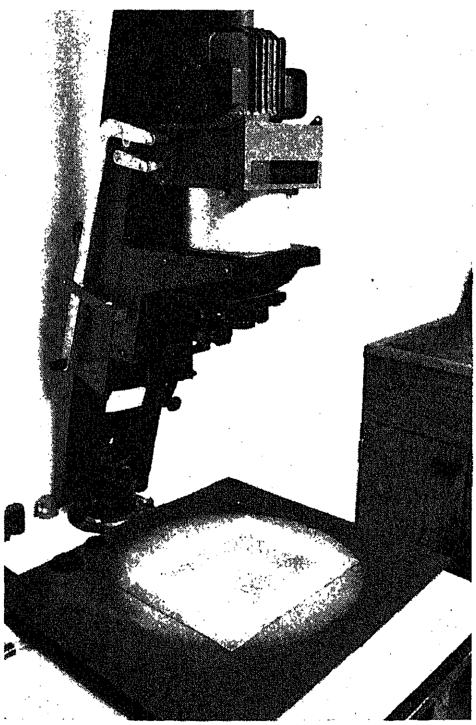
The light source for printing with a proof printer or glass and pad can be any controlled lamp. An overhanging light bulb or a safelight, with the filter removed, connected to a timer is a convenient arrangement. In most Navy photo lab print rooms, it is most convenient to use the enlarger as the light source.

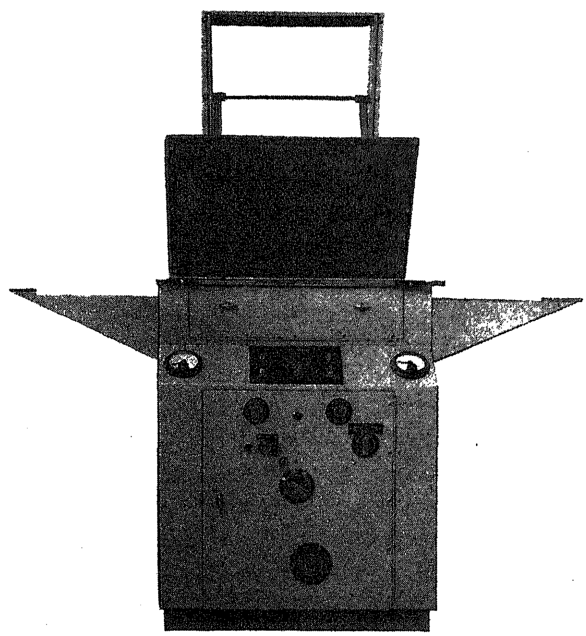
Contact Printer

For large volume contact printing, a contact printer is more convenient. A contact printer is basically a box with exposing lights, safelights, and viewing lights inside, with a glass top. It has a hinged pressure cover to hold the negative and paper in contact during exposure. Switches on the printer are used to control the lights in the printer and the printer may have a built-in timer or be connected to a timer.

All contact printers are built around the same basic idea. However, the manufacturer's instructions which accompany the contact printer you will be using should be consulted for specific operating instructions.

A useful feature on contact printers is an adjustable masking device. This device is attached to the printer so that it fits snugly over the printing glass. The mask consists of thin metal leaves which are used to "frame" the negative, making it possible for the prints to have white borders or margins. To produce prints with white borders, when using printers that are not equipped with a masking device, substitute masks that have been hand-cut from thin black paper can be used.





Courtesy Miller-Holzwarth, Inc.

The fundamental steps necessary to produce a print when using a contact printer are as follows:

- The negative is placed emulsion side up on the printing glass.
- The printing paper is placed emulsion side down over the negative.
- The platen or pressure cover is brought forward and down into the printing position.
- The printing light(s) are turned on for the required exposure time, then turned off.
- The platen is released, and the paper is processed.

When examined under white light, a negative is seen to have a shiny side and a dull side. The shiny side is the film base; the dull side is the emulsion side. A similar examination of photographic paper, under safelight illumination, especially the glossy surface kind, reveals that the paper has a shiny side and a dull side. In this case the shiny side is the emulsion side; the dull side is the paper support. Photographic paper normally has a slight curl toward the emulsion side, although this is not true in all cases. The curl toward the emulsion can be a valuable clue in the case of rough textured papers.

To make contact prints, the dull side of the negative must be in contact with the shiny side of the paper; that is, they must be emulsion to emulsion. If the negative base is in contact with the paper emulsion, the photograph will be reversed from side to side. In some cases, such a reversal in the print is not easily evident, but it becomes strikingly so if there are letters or numbers in the picture.

CONTACT PRINTING PROCEDURE

Check the lamp size and filters of all safelights to make sure they compare favorably with the recommendations given by the manufacturer of the printing paper you are to use. Rinse the trays with freshwater, and prepare the developing, stop bath, and fixing solutions. The trays should be larger than the prints to be produced, and one of the largest or deepest trays available should be used for the fixing bath.

When the solutions are ready, rinse and dry your hands. A supply of printing paper should be available and conveniently near the printer. An empty print paper box for holding the exposed prints should be placed near the printer if the prints are not to be processed as soon as each is exposed.

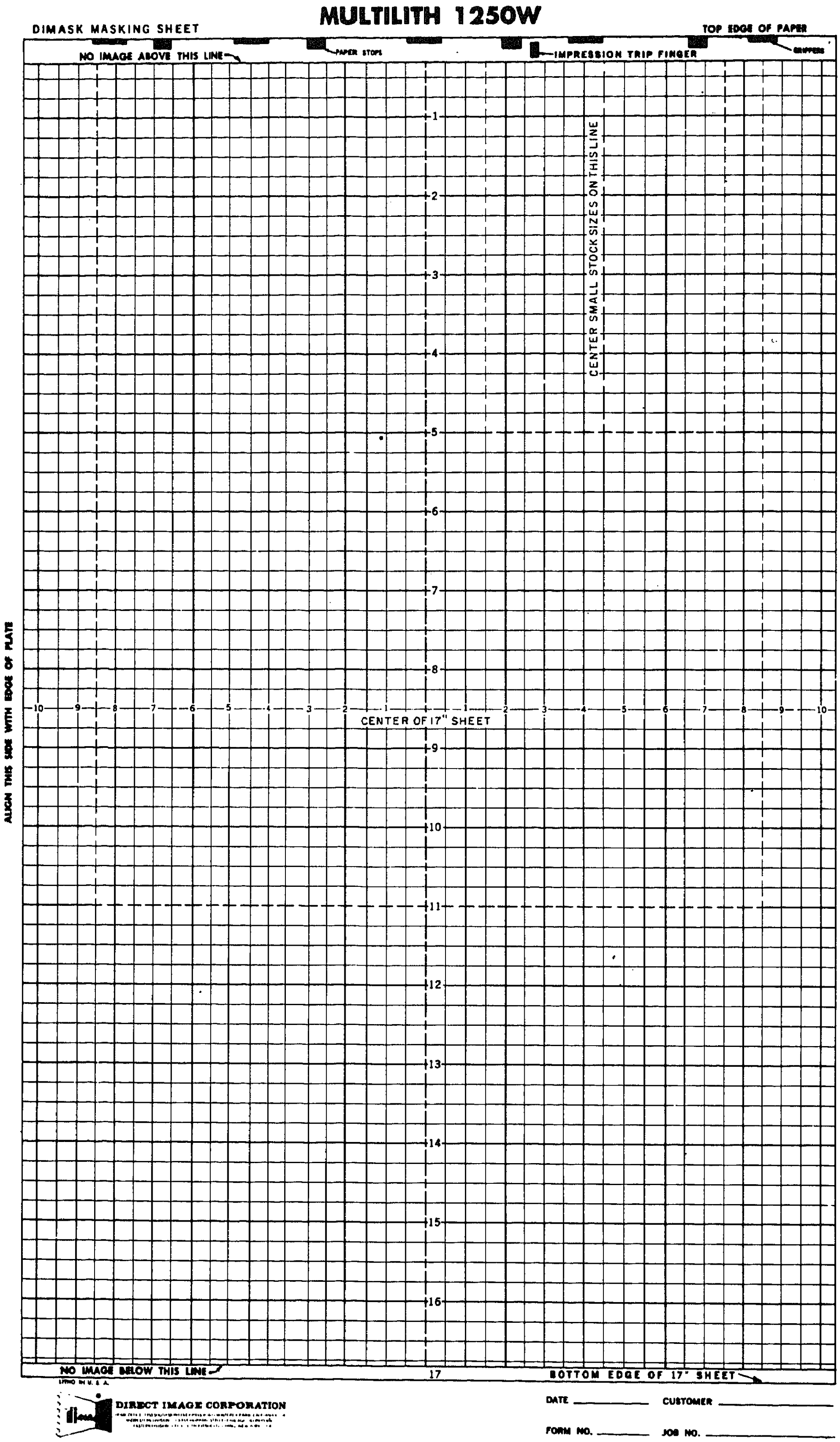
Masking the Negative

If the contact prints you are going to make require white borders, some type of mask is needed to prevent the printing light from exposing the edges of the printing paper. If the printer is not equipped with a masking device, a mask will have to be made to fit the negative. (Proof prints do not usually require masking.) The material used for masks should be opaque and not much thicker than typing paper. If the masking material is much thicker, and is used on top of the negative, it causes a distinct blurring along the edges of the print image area.

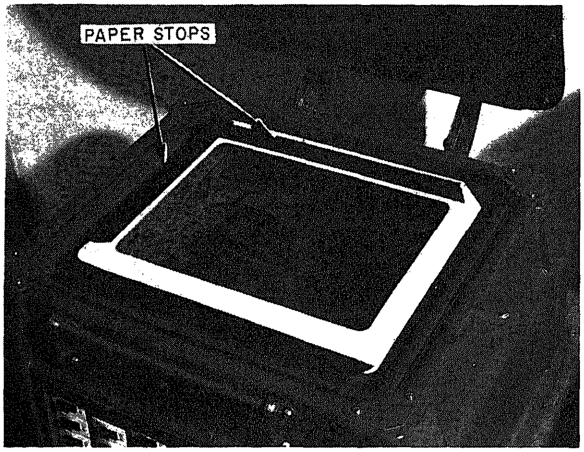
A good material for making masks is known as goldenrod—because of its color—usually yellow. This masking material prevents light from exposing the nonimage areas (borders) of the print.

Goldenrod has been preprinted with grid (guide) lines which allow you to position the negatives, or cut out the negative opening without requiring you to rule in lines as must be done when using plain paper masking material.

Some type of guideline, or paper stop, should be placed at one end and one side of the mask opening. The paper stop forms a square corner guide for quickly aligning the edges of the printing paper evenly and parallel with the opening in the mask, and helps keep the borders even on the print. The paper or tape corner guide or stops may be quite thick without causing poor contact



A preprinted goldenrod masking sheet (reduced in size).



Black masking tape used as paper stops.

between the negative and printing paper during exposure.

Printers equipped with metal strips (the masking device described previously) permit masking by setting the strips to frame the negative as desired.

The negative and printing glass should be cleaned prior to placing the negative on the printer. Place the negative, emulsion side up, on the printing glass and arranged under the mask so the desired composition is obtained. When more than one print is to be made from a negative, the negative should be taped to the printing glass. *Tape the negative at the corners only.* If the negative is completely taped down, air may be trapped between it and the glass. When the platen or pressure cover is moved into the printing position, the air will not escape, and an unsharp print may be the result. If a handcut mask is being used, the mask should be taped to the glass along one edge before the negative is positioned.

Printing Filter Selection

Contact printing papers have a slower speed than enlarging papers and come in several contrast grades, usually from grade No. 1, for printing contrasty negatives, to grade No. 4, for printing "flat" (lacking good contrast) negatives. No. 2 grade is used to print negatives of normal contrast and No. 3 grade to print moderately flat negatives. However, graded papers, especially contact, are being used less and less in our Navy photo labs. Instead, like most professional photographers, we are using variable contrast or selective contrast enlarging paper for both contact and projection printing. Therefore, in this and subsequent discussions of black and white printing, we shall consider only variable contrast enlarging papers.

The first requirement in making a good print is a clean negative of correct density and correct contrast. The negative should be examined to determine whether it is a flat, normal, or contrasty negative; what printing filter is needed; and the approximate exposure time required. As a beginning darkroom worker, you may not be able to make these determinations with very much accuracy. However, in a short time and with a little experience, you won't have any trouble. In fact, in a little while you will be able to judge the negatives better than the chief who seldom works in the print room.

In analyzing a negative to determine the most suitable printing filter, be careful not to confuse contrast with density. When in doubt, or in lieu of experience, it is best to make test prints. If the test print is contrasty, another test print should be made with a filter that will lower the contrast. If the original test print lacks sufficient contrast, change to a filter with a higher number to increase the contrast. You may want to review the information on printing papers and printing filters in module 2 at this time.

TEST PRINT.—The printing exposure is the operation most likely to cause the inexperienced photographer trouble. Unlike most films, which can tolerate considerable overexposure and even some underexposure and still yield usable photographs, printing papers must be correctly exposed to produce good prints.

Experience and familiarity with printing equipment does help, but, for the beginner, the correct exposure for prints from most negatives is best determined by making test prints.

The factors upon which exposure depends are:

- The intensity of the printing lights.
- The distance between the printing lights and the printing glass.
- The sensitivity of the printing paper.
- The density of the negative.

The first three factors are standardized and, therefore, eliminated as variables by using the contact printer and by printing with the same type of paper. The only remaining variable then is negative density, which can be determined by simply making a few test exposures. The duration of exposure for a negative of average density being printed may be approximately 1 to 3 seconds. If the negative is large, avoid the expensive and wasteful temptation of using a whole sheet of paper; use a strip about 2 inches wide and as long as the negative for the test exposure. For example, an 8 × 10 inch sheet of paper can be cut crosswise into three or four small strips.

After the filter and the *test* exposure time have been decided upon, set the timer for the estimated (test) exposure time. Place the paper test strip over the negative in the printing position. The test strip of paper should be placed on the negative so the test exposure includes some highlight, some halftone, and some shadow areas. Hold the paper in position with one hand and start the printing cycle by placing the platen into the printing position. As soon as the platen grips the edge of the paper, move your hand out of the way. When full platen contact pressure is reached, the printing lights are turned on for the test exposure time.

When the test strip has been exposed, develop it for the recommended time. If the image is too dark, the exposure was too long. If, on the other hand, the image is too light, the exposure was too short.

It is difficult for even an experienced photographer to judge the contrast of a print that has been underexposed or overexposed. Hence, if the test print is too light or too dark, the exposure should be changed until the proper density is attained with normal development before attempting to judge the correctness of print contrast. A normally exposed print develops gradually but steadily—shadows first, then halftones, and finally highlight detail. The image should appear in about 10 to 20 seconds, assuming the developer is at the proper strength and temperature. If the image develops very quickly with a general mottling, it was overexposed and the next test should be given less exposure. An overexposed print develops in a very short time, and the common temptation is to "pull" (remove) it from the developer, which prevents the image from going too dark, but results in a flat, muddy, uneven tone image. On the other hand, if the recommended development does not produce a print of the proper density, the printing exposure must be considered inadequate. After you have successfully exposed and processed a few prints, you rapidly acquire enough experience to estimate closely the density of negatives for contact printing exposures.

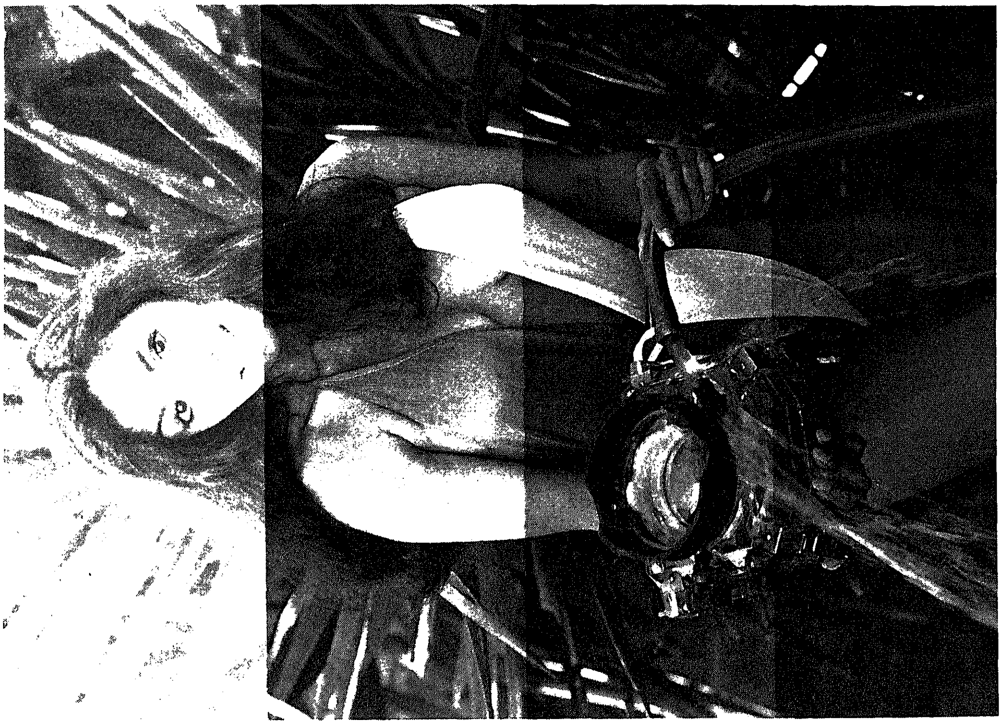
When a variation in exposure time does not yield a print of satisfactory contrast, a different printing filter is needed. If a properly exposed and developed test print lacks clean highlights and shadows, try a higher number printing filter. If the print is mainly black and white, with few middle tones, use a lower number filter.

When you have produced a satisfactory test print, you can make your production prints from that negative.

If a printing frame (glass and pad or proof printer) is used to make contact prints, the most convenient and economical way of determining exposure and correct contrast is to expose the test strip in progressive steps of say 2, 4, 8, and 16 seconds. This is done by exposing the entire test strip for 2 seconds, then by placing a piece of opaque card on top of the glass and covering one-quarter of the paper, give another exposure of 2 seconds. The card is then moved to cover one-half of the strip, and a further exposure of 4 seconds is given. Finally the card is moved to cover three-quarters of the test strip and an exposure of 8 seconds is given. The test strip is then given normal development and the correct exposure is determined by visual examination, in white light, of the four exposure steps.

If the correct exposure appears to be between two steps, the required exposure can usually be estimated with sufficient accuracy. However, further test prints may be needed.

After the exposure time and contrast for one negative have been found by tests, other negatives of similar density and contrast may be given the same filtration and exposure as a starting point. Negatives with widely differing contrast and density will at first require test prints, but with experience you will be able to judge most negatives without having to resort to test prints.



PH2 Noel R. Guest

1st Exposure	2 Sec.	2 Sec.	2 Sec.	2 Sec.
2nd Exposure	—	2 Sec.	2 Sec.	2 Sec.
3rd Exposure	—	—	4 Sec.	4 Sec.
4th Exposure	—	—	—	8 Sec.
Total Exposure	2 Sec.	4 Sec.	8 Sec.	16 Sec.

A processed test print for determining the required printing expsoure.

Exposing and Processing Prints

When a test print develops in the recommended time, rinse it in the stop bath, immerse it in the fixing bath for about 1 minute, rinse it in freshwater, and inspect it carefully under adequate white light. If the density and contrast of the image look correct under white light, printing should proceed by making the first "straight print."

Place the sheet of printing paper, emulsion side down, over the negative in the printing position by aligning the paper edges with the paper stops on the mask (if a mask is being used). Hold the paper in the printing position with one hand, to keep it from slipping out of place when the platen first presses against its edge, and start the printing cycle as described previously. After the printing cycle is completed, remove the paper for processing. Any number of duplicate prints can be made by repeating the printing cycle the required number of times.

Drop the print, emulsion side down, into the developer. Immerse it immediately with a quick sliding motion while pushing it under the surface of the solution. Grasp one edge of the print, lift it up, and turn it over. Replace the print emulsion up, on the

surface of the solution, push it under the surface again and leave it under during the remaining time in the developing tray. The print must be immersed rapidly and evenly to prevent the formation of air bubbles on its emulsion surface, and to ensure that all of the emulsion is wet with developer in the shortest time. Agitation for the remaining developing time should be constant.

Each type of printing paper has its own working characteristic, differing mainly in the length of time required to develop the image in a given type and strength of developer. A correct print is one that develops to the proper density and contrast in the recommended time. A print should be exposed so that it reaches the proper density and contrast *only with full development.* Otherwise, its tone and appearance will be below acceptable standards. If the exposure is insufficient, the image will not develop to the desired density, even with longer time in the developer, and appears pale and lacking in brilliance. Stains may also occur if development is carried out too long. If the exposure is too great, the image becomes too dense or dark before the recommended developing time has elapsed. If removed (pulled) from the developer with less than the recommended time, the prints may have a mottled, greenish appearance.

> Printing paper developers work more rapidly than those used for films. Consequently, print immersion must be quick and even, and agitation should be constant.

When the print is fully developed, lift it out of the developer, drain it momentarily, and place it in the stop bath.

After about 5 seconds in the stop bath, lift the print, drain it briefly, and place it in the fixing bath. Move it around in the fixing bath for a few seconds and examine it for any defects which might cause it to be discarded. When the inspection is completed, place it, emulsion down, in the fixer and complete the fixing process. Follow the manufacturer's instructions as to the required fixing time.

Some papers have a tendency to float in the fixing bath, especially if the bath is mixed a little stronger than usual. When prints float in the fixer, they should be handled constantly, or turned facedown to prevent the emulsion from being exposed to the air. The parts of a print exposed to the air during fixing may become stained.

When prints float face down, no trouble should be encountered except the possibility of air bubbles being formed under the prints. Air bubbles under a print produce stains and must be prevented. Immersing the prints edgewise and face down eliminates the air bubbles.

Each new print entering the fixing bath should go under all the others, thereby ensuring that fresh solution reaches the print during the first few seconds of fixing. Shifting of the prints in the bath should be done so no bubbles of air are formed.

When transferring a print from one solution to another, the few seconds of draining proves worthwhile. Proceeding along the production line of trays, from developer to fixer, each solution is designed to slow down or stop the action of the preceding solution. If an excess of any solution is carried into the following one, the strength of that solution is exhausted sooner than it should be, and replacement becomes necessary at an earlier time. Loss therefore occurs from two sources—the waste of chemicals and the waste of time from having to mix fresh solutions more frequently.

TWIN BATH FIXING TECHNIQUE.—The use of two fixing baths is recommended for thorough fixation, especially when many prints are processed daily. This procedure results in a more uniform and thorough fixation, conserves chemicals, and speeds production. Use two trays of fresh fixing solution at the start, with 1 gallon (or other suitable volume) in each tray. After the prints are developed, drained, placed in an acid stop bath, and then drained for a few seconds, immerse them in the first tray of fixing solution for about 3 to 5 minutes. Then remove and drain for a few seconds, and place them in the second tray of fixing solution for about 3 to 5 minutes. Drain the prints for a few seconds, and then immediately transfer them to the wash.

the slightly used second tray of fixer solution into its place as the first fixer, and pour fresh fixer into the second tray. Repeat the same fixing procedure, and continue until five cycles have been completed; then reclaim the silver from both trays of fixing solution, thoroughly clean the trays, and begin a new series of cycles, starting with two completely fresh trays of fixing solution.

Use of the twin bath system is not limited to only 1-gallon quantities of fixing solution. Where a production operation makes necessary the use of larger and deeper trays, the same system is applicable. For example, if 3-gallon fixing trays are required, then 600 8 × 10 prints (or equivalent) are the limit for the first 3-gallon tray of fixer, which is then replaced by the second 3-gallon tray of fixer solution. Then, a fresh fixer solution is used as the second fixer. This continues on through five cycles, then both trays of fixer are replaced.

By using the twin bath fixing system, a 30- to 60-percent savings in chemicals is possible. Use of the twin bath system almost doubles the number of prints that can be adequately fixed at only half the cost.

GROUP PRINT DEVELOPMENT.—Several prints may be processed at one time provided they are sufficiently separated and agitated during the process to assure uniform access of solutions to all parts of each print.

When processing several prints at one time, they should be immersed in the developer separately at regular intervals and, at the end of the proper developing time, removed in the same order and at the same regular intervals. To prevent the prints from sticking together, each one should be completely immersed before the next print is put in the developer. Agitation should be accomplished by rotating the prints in the solution; that is, take each print, in turn, from the bottom of the tray and place it on top of the other prints.

As the prints reach full development, transfer them one by one to the stop bath. Treat them for

inspected by white light, but they should be promptly returned to the fixer for complete fixing.

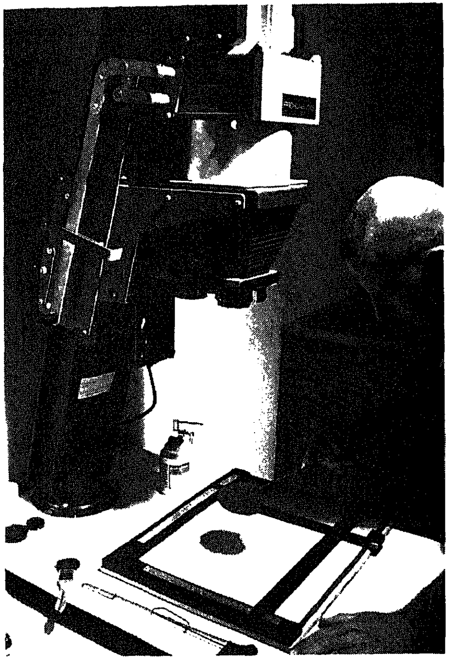
Print washing and drying will be discussed in a latter section of this chapter.

Local Control in Contact Printing

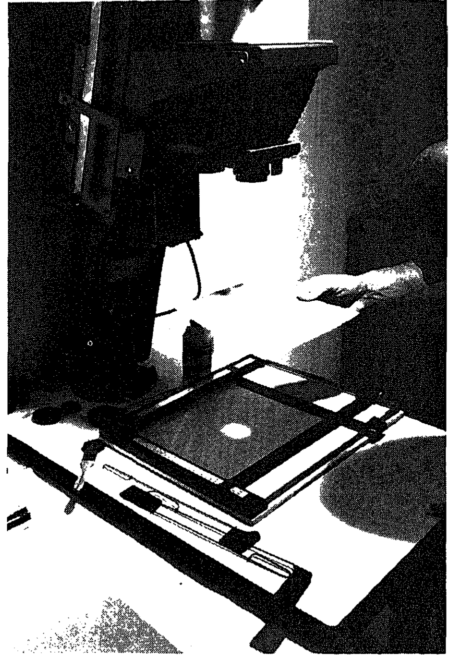
Print quality can usually be controlled sufficiently by selecting the correct printing filter and exposing the paper properly. However, to control the printing exposure of a small area within a photograph is another matter. Sometimes one area of a negative may be too dense or too thin and may require more or less exposure than the surrounding area in order to produce a print of uniform density. This can be remedied by two forms of local exposure control termed "dodging" and "burning in". There are a number of local control procedures, and skill with them is one of the marks of a professional photographer.

Control of exposure of specific areas of a contact print can be done by interposing an opaque piece of card or paper between the negative and the printing light source. The opaque material is kept moving during the exposure to prevent the formation of a "hard" edge to the shadow cast by it. The use of this opaque dodging "tool" permits control of the time during which light falls on various and *selected* areas of the negative and thus the paper.

When using a proof printer or the glass and pad, if a straight print (a print made without dodging or burning in) has an area which is too dark as compared to the rest of the print, that part of the negative can be shielded from the exposing light by the dodging tool for a part of the overall exposure. The shielded area therefore receives less exposure than the rest of the paper. This is termed "holding back" or "dodging." If an area of the straight print is too light, exposure for that area can be extended beyond the time suitable for the print as a whole, to give added exposure to the selected area. This is referred to as "burning in" or "printing in." It is accomplished by shielding



Dodging;



Burning in.

the greater part of the negative for part of the exposure time. The correct combinations of exposure in either case, dodging or burning in, are best arrived at by making test prints.

When a contact printer with numerous individual printing lights is used, dodging can be done by turning off one or several of the lights for part or all of the overall exposure time. When this is done, those lights under that part of the image to be dodged are turned off.

When turning off printing lights does not provide sufficient dodging or when a printer which uses only one printing light is used, dodging can be done by laying pieces of translucent material, such as tissue paper or thin white paper, on a sheet of clear masking glass in the printer an inch or so below that area of the negative to be dodged. The pieces of paper are torn to the required shapes and placed on the glass below the negative. Since the dodging papers are torn and not cut, and because they are some distance from the negative, the edges don't cast sharp shadows—even though they are stationary.

If the dodging papers tend to curl, place a sheet of glass on top of them.

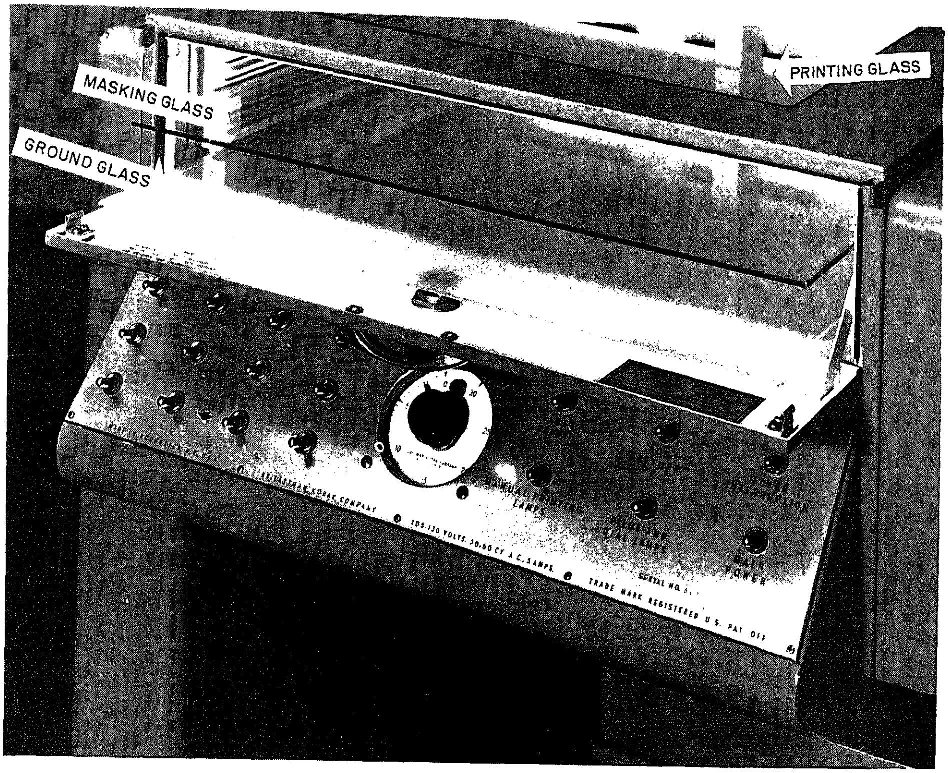
This type of dodging takes some time to set up, but once set up, any number of prints can be made and they will all be dodged or shaded exactly the same. More than one piece of tissue may be required, depending on the quality of the negative.

A good print shows all possible detail in both the highlights and the shadows. Cleanliness is essential to producing good prints consistently. Keep a supply of clean towels handy, and wash and dry your hands before handling printing papers. *Clean, dry fingers should touch only the extreme edges of the emulsion side of these papers.* It is almost impossible to touch the emulsion side without leaving fingerprints which develop and show clearly on the finished prints. If possible, use two print tongs—one for the developer and one for the stop and fixing baths.

It is poor economy to use minimum quantities of developer. Small quantities oxidize (turn brown) very quickly. An oxidized solution cannot produce clean, brilliant, pleasing pictures.

PROJECTION PRINTING

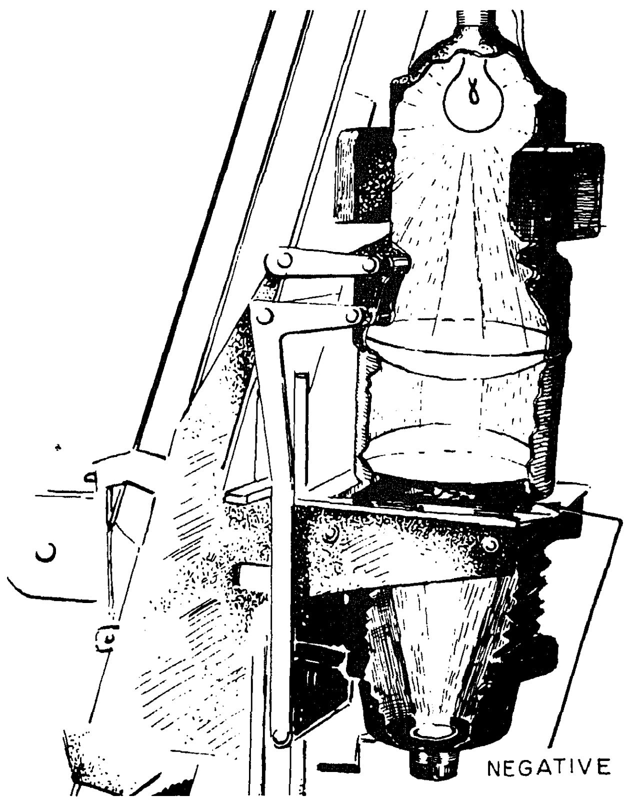
Projection printing is the process of making positive prints by optical projection of the negative image onto photo sensitive paper. The projected image may be enlarged, the same size as the negative image, or reduced in size. When



the print images are larger than the negative images, the process is called enlarging; when the print images are smaller than the negative images, the process is called reducing. Because projection printing is usually used to make positive prints with images larger than the negative, projection printers are usually referred to as enlargers, and the term "enlarging" generally refers to all forms of projection printing.

Projection printing varies from contact printing in that the negative is separated from the paper and the image is projected, by means of a lens, onto the sensitized material. The negative is placed between an enclosed light source and a lens. The lens receives the light that passes through the negative and projects the image onto the paper. Changing the distance between the lens and the paper controls the size of the image. The image is focused on the paper by adjusting the distance between the negative and the lens. Thus, it is possible to enlarge or reduce the size of the projected image by simply changing and adjusting these distances.

Enlarging is a very adaptable and versatile process in which considerable image and exposure control can be exercised. Although the main



An enlarger.

advantage of enlarging over contact printing is that large prints can be made, there are several other important advantages, among which are:

- Cropping or selecting the main area of interest in a negative, and enlarging this area to any suitable size. This gives you the opportunity to eliminate unwanted and distracting elements from around the picture's point of interest.

- Dodging or burning in. This enables you to apply local exposure control to bring out more detail in the highlight and shadow areas.

- Local fogging with a small external light, such as a penlight, to darken selected areas. For example, to darken the background of a portrait to direct viewer attention to the face.

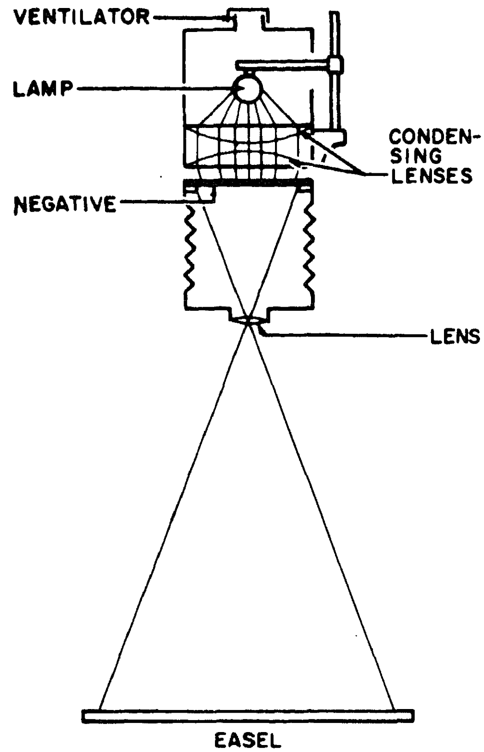
- Special effects such as changing the appearance of the image by use of diffusers or patterns, etc., between the lens and paper.

- Image distortion correction or introduction by tilting the enlarger easel. (An easel is an apparatus used to hold the paper during exposure.)

ENLARGERS

In general, all enlargrs are similar in design and operation. They have an enclosed light source, some method of obtaining an even distribution of light over the negative, a negative carrier, a lens, a means of adjusting the lens-to-negative and the lens-to-paper distances to allow for different degrees of enlargement or reduction. The degree to which the image is enlarged may be referred to in terms of diameters. For example, a two diameter or 2X enlargement is twice the length and twice the width of the negative image, or four times the area. A three diameter or 3X enlargement is three times the length and width of the negative image, or nine times the area.

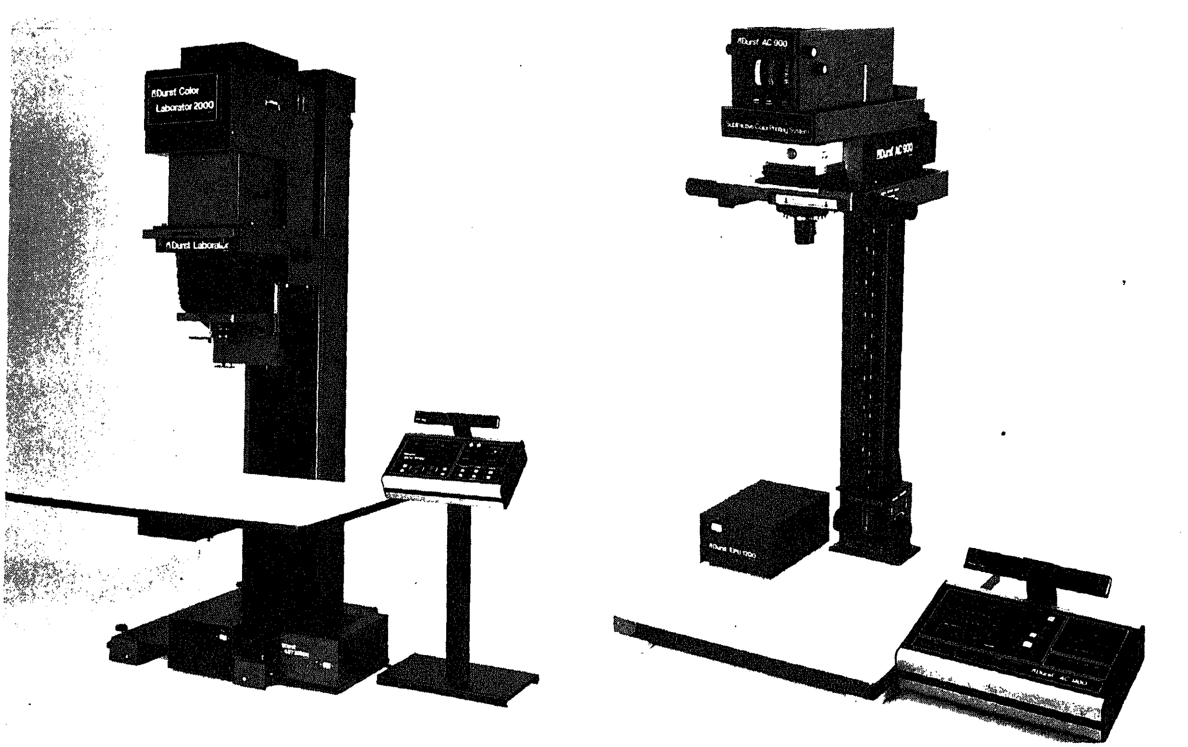
Most enlargers have a tungsten lamp as a light source. The lamp is enclosed in a lighttight housing which is ventilated to prevent excessive lamp heat from damaging the negative. Some enlargers have blowers to circulate air and cool the inside of the lamp housing.



The negative carrier used in an enlarger may be either a dustless type or a glass sandwich type. The dustless-type carrier is made of two metal plates with an opening in the center large enough to hold the negative. The negative is placed between these plates and is held in position by its edges. This type of carrier is good for negatives 4 × 5 inches or smaller, since these negatives are stiff enough to remain flat. The glass sandwich-type carrier is a holder with two sheets of glass between which the negative is placed. A holder of this type is used for larger negatives since they have a tendency to sag in the center if they are used in dustless carriers.

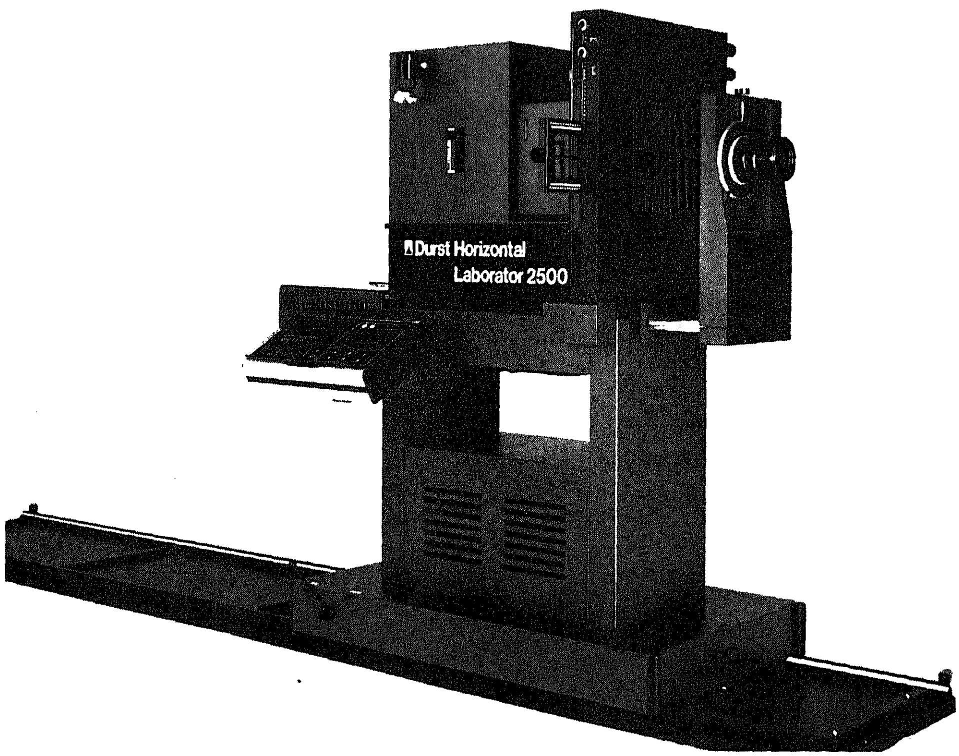
The lens used in an enlarger should have an angle of field large enough to cover the negative being printed. A lens with a focal length approximately equal to the diagonal of the largest negative to be printed will provide sufficient angle of field.

The bellows of an enlarger should be able to extend to at least twice the lens focal length. This amount of bellows extension is necessary for making 1:1 reproductions. Although it is possible to make reductions to any desired size, the bellows on most enlargers can't be extended far enough to make reductions smaller than 1:1. Smaller reductions can be made by using a longer focal



Courtesy Durst North American, Inc.

Vertical enlargers.



Courtesy Durst North American, Inc.

Horizontal enlarger.

length lens, but a better method is to use a reducing attachment. A reducing attachment may consist of a section of supplementary bellows fitted with a longer focal length lens. The regular enlarger lens is not used when the reducing attachment is being used.

The systems used to distribute the light evenly over the negative divide enlargers into three general types—*condenser enlargers, diffusion enlargers, and semidiffusion enlargers.*

CONDENSER ENLARGERS

A condenser enlarger has a set of condensing lenses between the light source and the negative. The condensing lenses concentrate or focus the light from a light bulb in such a way that the light rays pass straight through the negative to the lens.

The condenser lenses are a pair of planoconvex lenses mounted as a unit with their convex surfaces opposed, or face to face. A condenser enlarger produces a sharp brilliant image, having more contrast and detail than with the same negative in a diffusion enlarger; thus, negative defects, such as scratches, very often become quite apparent in the print made with a condenser enlarger.

DIFFUSION ENLARGERS

A diffusion enlarger has a diffusion screen (usually ground or optical glass) between the light source and the negative. Light from the lamp, as well as the light reflected from the reflector of the lamp housing falls on the diffuser, which, in turn, scatters the light. Thus, the light, after passing through the diffuser, is traveling in many directions when it falls upon the negative.

The effect of diffused illumination is that negative defects are not recorded as clearly in the print as they would be with a condenser enlarger. There is an overall "softening" of the image sharpness and a reduction in image contrast.

Differences Between Condenser and Diffusion Enlargers

Most of your negatives can be enlarged equally well with either a condenser or diffusion enlarger. However, for certain work the choice of enlarger may be an important factor.

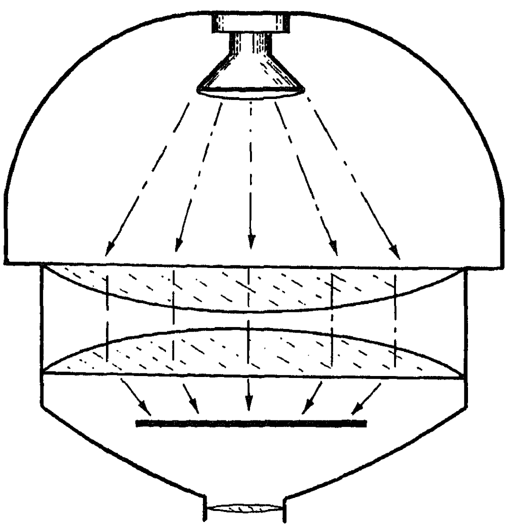
The main differences between the two types of enlargers are:

Condenser enlarger

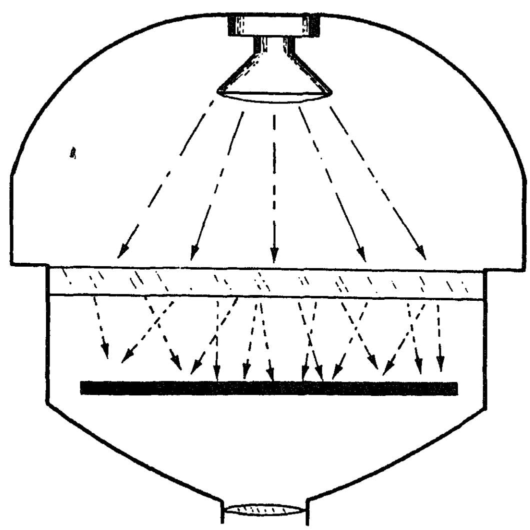
- Produces maximum tone separation.

- Is suitable for making prints to a high degree of enlargement because of its optical characteristics.

- Is capable of producing higher image contrast with a given negative than printing with a diffusion enlarger or contact printing.



Condenser enlarger.



Diffusion enlarger.

ave been retouched because the edges and ridges f the retouched areas may print as dark lines.

- Negative defects and the silver grain, etc., ıay be accentuated.

Condenser enlargers should be considered for se when large prints are required and retouching as not been employed; e.g., for industrial-type hotography.

Diffusion enlarger

- Should be used for printing negatives hich have been retouched.

- Subdue negative defects, grain, etc.

- For a given negative, image contrast with diffusion enlarger is less than that produced with condenser enlarger.

- Are not suitable for making very large rints because of the softness of the image roduced.

Diffusion enlargers should be considered for se in portraiture and when the negatives have een retouched.

CONDENSER-DIFFUSION NLARGERS

A condenser-diffusion enlarger or emidiffusion enlarger is a compromise between he two extremes of condenser and diffusion. A ondenser-diffusion enlarger uses a diffusion frosted) bulb and condensers, or a diffusion bulb ith either a diffusing glass over the condensers r else one of the condensers itself acting as the liffuser.

A condenser-diffusion enlarger, to an extent, as the advantages of a diffusion enlarger to educe the effects of negative defects, silver grain tructure, dust, etc., while at the same time naking use of the condenser system to give the peed and uniformity of light produced with a ondenser enlarger.

The enlargers in general use in most of our Navy photo labs are the condenser-diffusion type; hat is, they use frosted or diffusion bulbs, with r without a diffusion screen placed above the ondensers.

As with a camera, the enlarger's lens is its heart and should be of high quality and reasonably fast. There is not much sense in buying good lenses for the camera, then nullifying the quality they provide with an inferior enlarging lens. However, don't get the idea that the fine camera lens you use is suitable for enlarging. It isn't. In fact, even a moderately good enlarging lens is better for enlarging than most camera lenses.

The focal length you use with an enlarger should be based on the size of the negative to be enlarged. Generally speaking, the focal length of the enlarging lens for a given negative size should be the same as the normal focal length lens for the camera used to make the negative.

Enlarging lenses focal lengths
for various negative sizes

Negative size	Lens focal length
35mm	50mm
120 (2 1/4 × 2 1/4) (6×6 cm)	75mm
120 (2 1/4 × 2 3/4) (6×7 cm)	105mm
4×5	135-150mm

While it is not necessary that the lens cover the full area of the negative, the longer the lens focal length, the less magnification you will get at a given lens-to-paper distance. Therefore, it is desirable to have several lenses of various focal lengths available for your enlargers if you want to make large prints from small portions of your negatives.

Because an enlarger produces an image from a flat field (the negative) onto a flat field (the paper), depth of field is not of consequence—except when distortion control, which will be discussed later, is employed. An enlarger lens can usually be used at large f/stops. However, if an enlarger lens is used at its maximum aperture, there may be some fall off of light at the edges of the circle of illumination. Therefore, an enlarger lens is usually stopped down one or two stops from wide open. And just like a camera lens, when an enlarger lens is used at very small apertures, there is a loss of image definition due to diffraction.

ENLARGING PROCEDURE

The darkroom design, the equipment, and the arrangement for enlarging are basically the same as for contact printing. The safelights should be appropriate for the type of paper being printed. The size of the prints may require larger trays and greater amounts of solution, but they should be arranged in the sink in exactly the same order as described for contact printing. D-72 developer is just as effective with enlargements as with contacts.

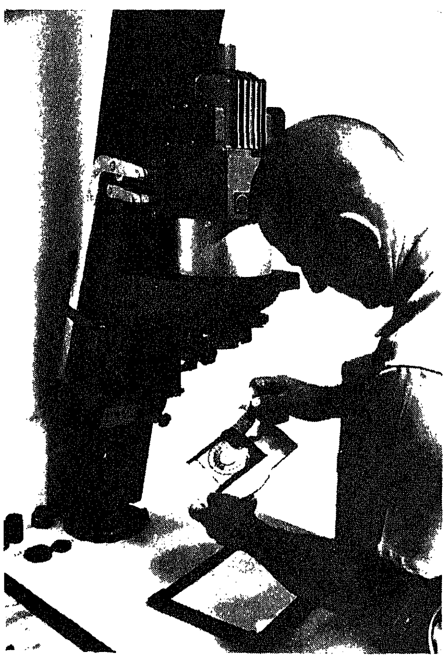
From the easel, the exposed paper goes to the developer, to the stop bath, to the fixer, and to the wash. With all in readiness (the correct filters in the safelights, the processing solutions mixed and arranged properly, and the printing paper placed conveniently near the enlarger), production then proceeds by making the projection test print.

The prerequisites for good enlargements are good negatives, a clean enlarger, clean printing filters, correct exposure and development, and careful processing and finishing. Although most any negative can be printed by projection, there are a few characteristics that are particularly desirable. A good negative has normal density and contrast. It is sharp, and free from such defects as scratches, abrasions, dust, lint, and fingerprints.

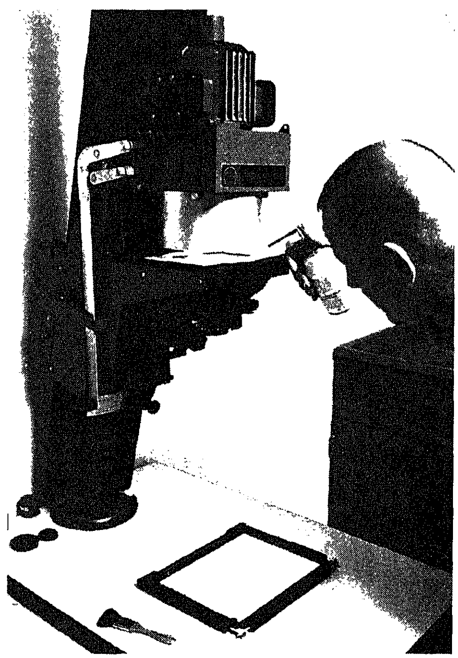
ENLARGER AND EASEL ADJUSTMENTS

Insert the negative in the negative carrier so that the emulsion side will be down when placed in the enlarger. In other words, the base of the negative (the shiny side) should be up or facing the lamp when inserted into the enlarger. Clean the negative; make sure there is no dust on it. You can use the light from the enlarger to check for dust. Blow off any dust with a bulb syringe or low-pressure air; then using a camel's hair brush, brush or lift off any dust not removed with the air. With some enlargers you will be able to check the negative for dust a second time after the negative is in the enlarger. Replace the negative carrier with the negative into the enlarger and make sure it is properly seated.

Set the paper guide or masking device on the easel to form the border width needed or use a preset easel. As an aid for composing and accurately focusing the image, place a sheet of



Cleaning dust from a negative with a camel's hair brush.



Blowing dust from a negative with "canned air."

vhite paper in the easel—the base side of a finished print serves nicely for this *focusing* heet—then turn out all white lights.

Turn the enlarger lamp on, open the lens to ts maximum aperture, and move the easel around intil the desired portion of the image is in the picture area. Raise or lower the enlarger unit on he upright standard or column, focus the image, hift the easel as needed, and continue these djustments until the image is enlarged (or educed) to the desired size, in sharp focus, and composed correctly on the easel.

> The size of projection prints is limited by the optical system used and the working space available. To a lesser degree, the size of the printing paper governs the size of prints; but a scene may be printed in sections on several sheets of paper, and these sections spliced together.

The picture is easier to compose with the scene ight side up. If it is upside down from the printer's point of view, either rotate the negative carrier or remove the carrier and reposition the negative.

The easel should be moved around until the best composition is obtained. While composing he image, try to correct any errors of image composition in the negative. In many cases, the vay the scene is composed on the negative may be a controlling factor in the final composition. Straighten the horizon, and, if possible, prevent t from cutting the print image in half. If the horizon is not to be included in the print, make ure vertical objects are parallel to the sides of he print. If the space around the point of interest of the picture is distracting, you can change the composition of the picture through cropping and/or greater or lesser enlarging.

After the image is correctly composed and focused, the lens aperture should be stopped down ufficiently to necessitate an exposure of about 0 seconds. An exposure of this length permits a normal amount of dodging and is fast enough o be practical for quantity production. The exact amount the lens should be stopped down depends on the density of the negative and the magnification of the image and is difficult to letermine without experience. If you are new to printing, we suggest you start by stopping down the lens to about f/8 or f/11 with a normal negative.

MAKING A TEST PRINT

There are many factors which affect exposure times in enlarging—some of which are:

- The light source and illumination system of the enlarger.
- The f/stop of the lens.
- The negative density.
- The degree of enlargement.
- The speed of the paper.
- And, to some extent, the density and color of the printing filter.

The best way to determine enlarging exposure is by means of a test print or strip. In this publication we will not go into detail about exposure meters for enlarging work. Even though they may be quite useful, they are not generally as reliable as a simple test strip.

Although the test strip is the most reliable way to determine exposure, it is not necessary to make a test strip for every enlargement. It is, however, a wise practice whenever you have any doubt as to the exact exposure required.

A test strip for enlarging is made very much the same way it is for contact printing. And as in making the contact test strip, when making the enlargement test strip, we must try to select the proper printing filter based on the negative contrast.

Once the printing filter has been decided upon, set the enlarger for producing the desired size prints. Set the lens f/stop at f/8 or f/11 for example. Next examine the projected image on the focusing paper in the easel and estimate how much exposure time you think the print will require. Assume that from past experience you estimate the correct exposure time to be about 15 seconds. Because your estimate may be too long or too short, a logical procedure would be to expose a test strip in four sections.

To make the actual test strip:

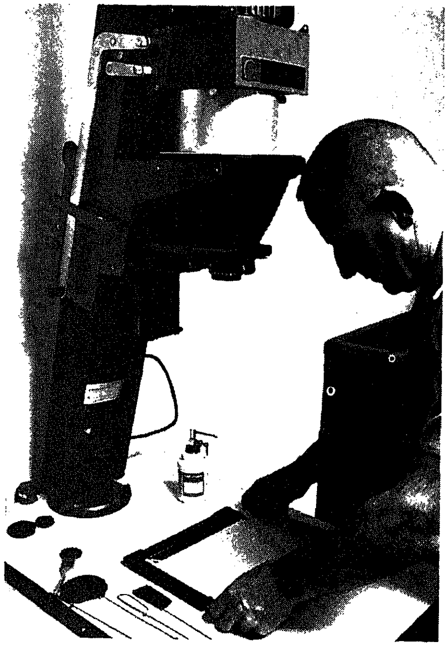
1. Place one test strip on the easel in a position that will sample the greatest possible gradation in tone.

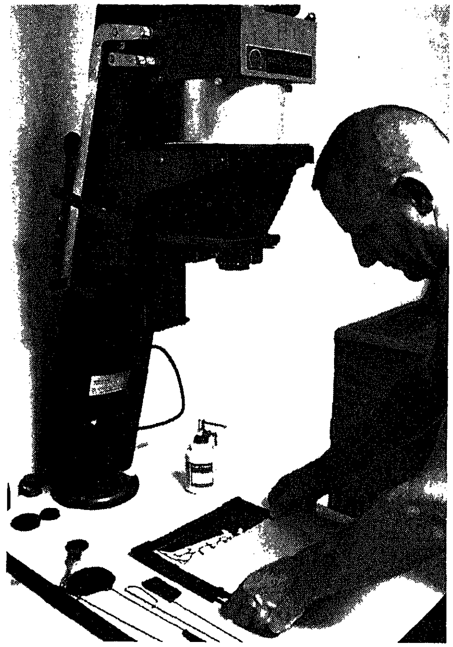
2. Cover three-quarters of the strip with opaque paper or cardboard and expose the uncovered section for 5 seconds.

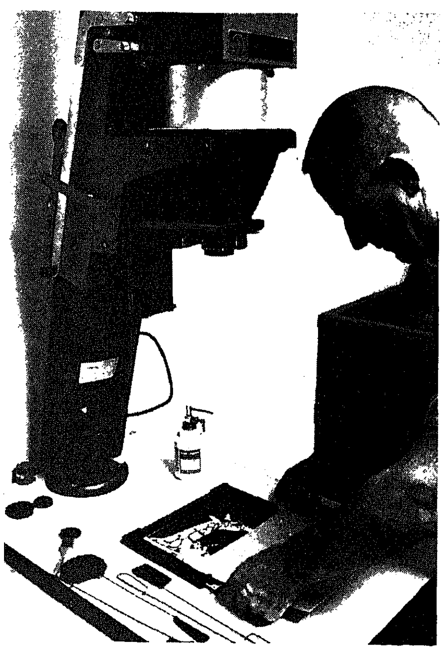
3. Move the cardboard to cover one-half of the strip and give another 5 seconds' exposure.

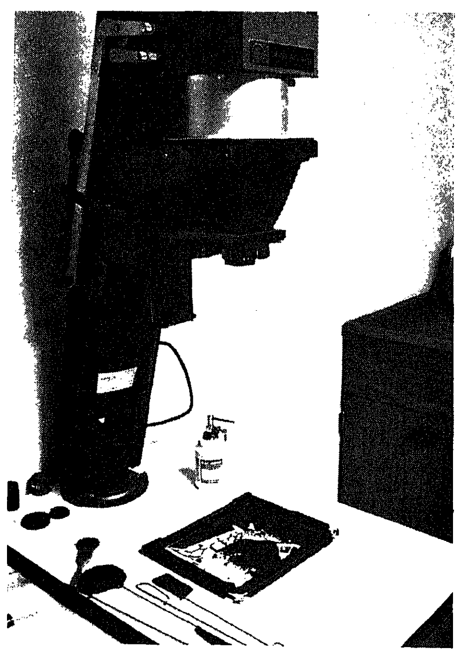
4. Again move the cardboard, this time to expose three-quarters of the strip and again give 5 seconds' exposure.

5. Now uncover the entire strip and expose it for another 5 seconds. This produces a strip with exposures of 5, 10, 15, and 20 seconds.









as for contact prints.

7. Examine the processed test strip under white light and select the segment representing the exposure that gave the best results. If a time between two sections would give the best results, make another test at the estimated time. When you have selected the best exposure, you are ready to make a full size print—if the contrast is correct. If not, change filters and make another test strip.

If none of the sections have the correct exposure, select the *best* exposure and make another test print based on your new estimate.

The primary purpose for a test print is to determine the correct exposure, but it can also be used to help you determine the correct contrast or printing filter to use. If the test print is too contrasty or too flat, make another test print with a different printing filter.

When printing, contrast—the difference in tonal value between the highlights and shadows—is as important to determine as the correct exposure. Almost without exception, Navy photo labs use variable contrast printing papers. To control contrast with this type of paper you use variable contrast printing filters. Unlike film, increasing the development time of paper does not significantly increase the contrast. In fact, when paper development is carried out much beyond the recommended time, contrast can actually decrease due to fogging. Likewise, short development times should not be used in an attempt to get lower contrast. The result of short paper development times is usually a print which has not fully developed, and the print will probably have poor tone quality and a "muddy" appearance.

Variable contrast filters then are the only practical way of altering print contrast with variable contrast papers. Variable contrast papers have orthochromatic sensitivity. The blue-light sensitive part of the emulsion controls high contrast and the green-light sensitive part controls low contrast. By interposing the appropriate variable contrast filter between the light source and the paper, the contrast can be controlled. Variable contrast filters range from yellow (for low contrast) through deep violet (for high contrast).

correct exposure, you need to also determine the contrast. You do this by examining the shadow area of the test strip that has the correct highlight exposure. If the shadow area of this test is too light, the test does not have sufficient contrast. If the test has insufficient contrast, a higher numbered filter is needed. If the shadow area is too dark, the test has too much inherent contrast and a lower numbered filter is needed.

The following table, which is based on using Kodak Polycontrast Filters and Kodak Polycontrast Paper, can be used as a guide in helping determine the correct filter to use. The principles also apply to the use of the intermediate filters such as 1 1/2, 2 1/2, or 3 1/2.

Polycontrast filter selection guide

Filter No.	Use
1	**Soft**—Normal prints from contrasty negatives, flat prints from normal and low contrast negatives.
2	**Normal**—Normal prints from normal negatives, flat prints from low contrast negatives, contrasty prints from contrasty negatives.
3	**Moderately High Contrast**—Normal prints from slightly low contrast negatives, contrasty prints from normal negatives.
4	**High Contrast**—Normal prints from low contrast negatives, contrasty prints from normal negatives.

The following series of pictures shows the difference in contrast obtainable from

PHCM Tom Regina

Polycontrast filter No. 1 **Polycontrast filter No. 2** **Polycontrast filter No. 3**

one negative by using different Polycontrast filters.

Here are a few points to remember when you are using variable contrast paper and filters.

- When in use, the filters should be clean and in good condition (not scratched, etc.). Like all filters, eventually the printing filters will fade and have to be replaced.

- The density of the filters changes with the different numbers. For example, a No. 4 filter is darker than a No. 3. This being the case, you should make test strips for each filter to determine the correct exposure time.

- It is possible to change filters to control local contrast. For example, it might be better to give the print an overall exposure with a No. 2 filter while holding back or dodging the sky and then burn in the sky with the aid of a No. 1 filter. When printing with more than one filter, it is a good idea to work from a full test print to determine the best approach.

- Study the manufacturer's directions that come with the paper so that you can use their filter/paper combination to best advantage.

Too many of us are guilty of throwing away the manufacturer's directions that come with our photo materials. By keeping them in a reference book, we would have a tremendous source of information which would save us time and materials.

Once you have determined the correct exposure and contrast, you are ready to produce the production prints. Until you become proficient in printing, you should make test prints for each negative you are going to print.

By adjusting the lens f/stop, longer or shorter exposure times than the determined test exposure time may be used provided they do not become excessive in either direction. Very short exposures are not practical. Very long exposures subject the negative to excessive heat from the printing lamp and also waste time. Five seconds is about as short an exposure time that should be used. Twenty seconds is about the longest exposure time that should be required for normal negatives. A standard procedure is to change the exposure by varying the f/stop of the lens to bring the exposure time within practical limits.

CREATIVE CONTROLS IN PRINTING

Enlarging is a creative procedure because of the many ways it permits you to control the final

appearance of the photograph. You can use printing exposure to make your prints lighter or darker; the contrast can be altered by your choice of printing filter. You also have other creative controls available such as cropping (composition), dodging, printing or burning in, vignetting, diffusing, image distortion correction, etc.

You should devote as much attention and care to printing as you do to actually making the original negative. Otherwise, you will do an injustice to your skill and reputation as a photographer.

COMPOSITION AND CROPPING

Enlarging or printing only a part of the entire image contained in a negative is termed "cropping." Cropping is the procedure in printing that is used to improve the photograph's composition. Most photographs are intended to present an idea or provide the viewer with some type of information. The better you make the composition of the finished picture, the better it will communicate the intended message.

Photographic composition is mainly controlled or established within and with the camera when the picture is taken, and so it should be. However, the vast majority of photographs can be improved during the printing process by cropping. Cropping can be used to eliminate distracting or unwanted scene elements, to straighten a tilted horizon, alter the center of interest, to strengthen leading lines, etc.

Since personal likes and dislikes differ, there can be no hard and fast rules for cropping. However, some rules of thumb may help you produce pictures that are pleasing to most people.

- Any elements at the edges of the picture area that may draw attention from the intended center of interest should be cropped out.

- The center of interest should not normally be placed in the physical center of the print. The center of interest should be somewhat to the left or right and a little below or above the physical center of the picture. The exact location for the center of interest will depend on the subject and the format of the print and your preference.

- Horizontal, vertical, and diagonal lines should not divide the picture into equal parts. The horizon in a photograph should be absolutely horizontal. The vertical lines of buildings, with one exception, should be vertical. The one exception is the vertical lines of buildings which naturally appear to converge. In which case, the central vertical line, either real or imaginary, should be depicted as vertical.

- People or animals, etc., shown in profile or near profile within a photograph, should appear to be looking into the picture, not out of it. For example, the subject should have more picture area in front than behind.

- Unless you are producing micro- or macrophotography, the printed images should not normally be larger than the actual size of the subject.

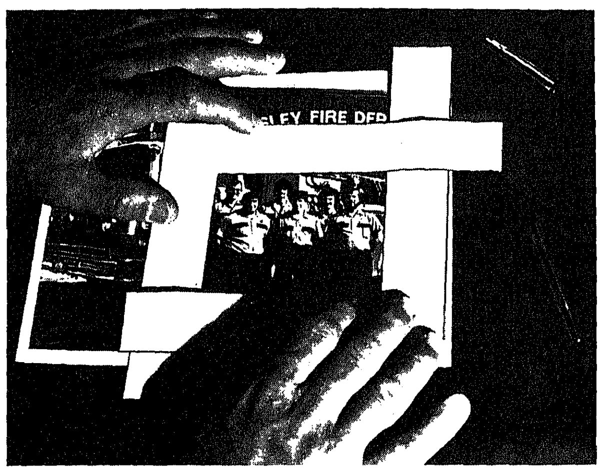
- The image area of a picture should appear to have a solid support. This effect can sometimes be achieved by printing the lower part of the picture somewhat darker than the upper part.

- In a landscape or seascape picture, print the foreground somewhat darker than the middle distance, and print the middle distance darker than the far distance. Then gradually increase the density of the sky from the horizon upward. In this way you will create a feeling or illusion of depth.

Cropping Procedures

A contact print (proof print) of the full negative to be printed will be helpful in determining the most effective cropping for the picture.

Have available a set of cropping arms such as the ones shown. Cropping arms can be cut from pieces of cardboard. Be sure the arms have true



Cropping arms being used to determine most effective cropping.

right angles. Follow this procedure to crop and/or mark the proof print:

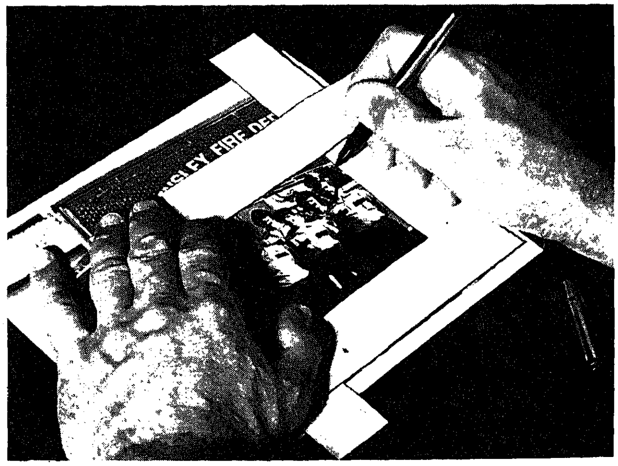
1. Place the cropping arms over the proof print and move them about until you have the desired cropping, composition, and picture proportion or format.
2. With the cropping arms held in place on the proof, mark the print with a grease pencil, or other suitable marker, to outline the desired area or composition of the picture. The marked proof print will be used as a guide to set up the enlarger and easel.
3. With the negative in the enlarger and the printing lamp turned on, adjust the enlarger to get approximately the desired image size and cropping. Use the proof print as a visual guide.
4. Adjust the adjustable masks on the easel to the correct format and desired cropping. The adjustable masking device on the easel should be adjusted so that at least a 1/4-inch white border will be left on all four sides of the finished print. Excess border can be cut off the print after it is processed.

> There may be occasions when you may want to produce prints with borders larger than 1/4 inch, or with borders of various widths such as 1/2 inch at the top and sides and 1 1/2 inches at the bottom, etc., or you may want prints without any borders or with black borders. To make a print without borders, cut the borders off after the print is processed or use a borderless-type easel.

5. As necessary, make final adjustments to the picture composition by moving the easel, changing the border masks, or by changing the picture enlargement or any combination of these until the projected image is the same as the cropped area in the proof print.

LOCAL PRINT CONTROL

No matter how good your or someone else's camera work is, somewhere in the negative there will probably be areas that won't print correctly. It is no exaggeration to say that a "straight" enlargement from any negative is seldom the best print that could be made from that negative. If



unsatisfactory, we may resort to manipulating the light while exposing the paper. This manipulation may be shading (dodging or holding back) to prevent part of the image from getting too dark, or it may be printing in (burning in) to produce detail from a part of the negative which is too dense. Local print control of this type can be used to compensate for uneven lighting of the scene photographed or to give more prominence to a selected part of the picture.

Dodging

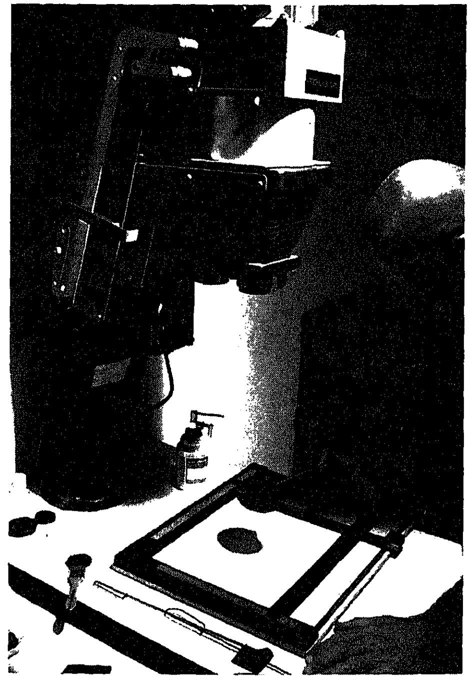
As we discussed previously in contact printing, it is often necessary to dodge or hold back some parts of images to produce a correctly exposed print. In projection printing, the dodging material is held and manipulated in the beam of light from the lens, so its location and coverage can be seen and controlled during the printing exposure. Hence, accurate dodging can be done with the hands or various shaped tools. (A favorite tool for dodging small areas in the image is a card of suitable size and shape attached to one end of a stiff wire.) The shadow of this dodging tool covers a small or large area, depending on the size of the tool and its distance from the surface of the printing paper. The dodging tool or "butterfly" is held between the lens and the printing paper in such a manner that it prevents light from falling upon the area being dodged. Dodging is generally necessary for only part of the total exposure time. The tool used must be moved constantly to prevent a sharp line between the area dodged and the other parts of the image.

Because light is held back from an area during

area of the processed print is lighter than it would have been if dodging had not been employed.

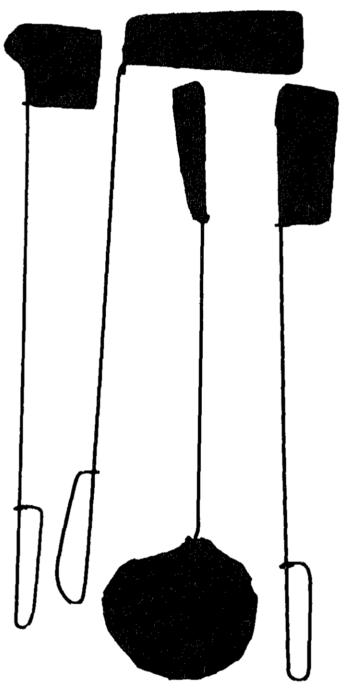
Dodging can be used for creative and corrective effects. Dodging is usually used to hold back shadow areas, thereby preventing the shadow areas from printing too dark and losing detail. For example, part of a person's face may be too much in shadow because of the hat he is wearing, while the rest of his face is brightly lighted. By dodging, or holding back some of the light from the shadow area of the face image, the shadow will not print too dark, thus a more pleasing and detailed photograph is produced.

The amount of time you should dodge can vary widely, depending on the subject, the overall exposure time, etc. Even an experienced printer may have to produce several test prints in order to determine the correct amount of dodging.



Holding back exposing light with a dodging tool.

DODGING TOOLS.—You can use your hands as dodging tools to cast a variety of different size and shape shadows to hold back unwanted light from the print. Some photographers prefer to use dodging tools such as the one we just described—stiff wires, to which are attached various size and shaped opaque or translucent materials such as black cardboard or crumpled cellophane. Another dodging tool is a loop of the desired size and shape at the end of a thin stiff wire; the loop is then covered with black masking tape. Even a plain piece of cardboard can make an effective dodging tool.



Dodging tools.

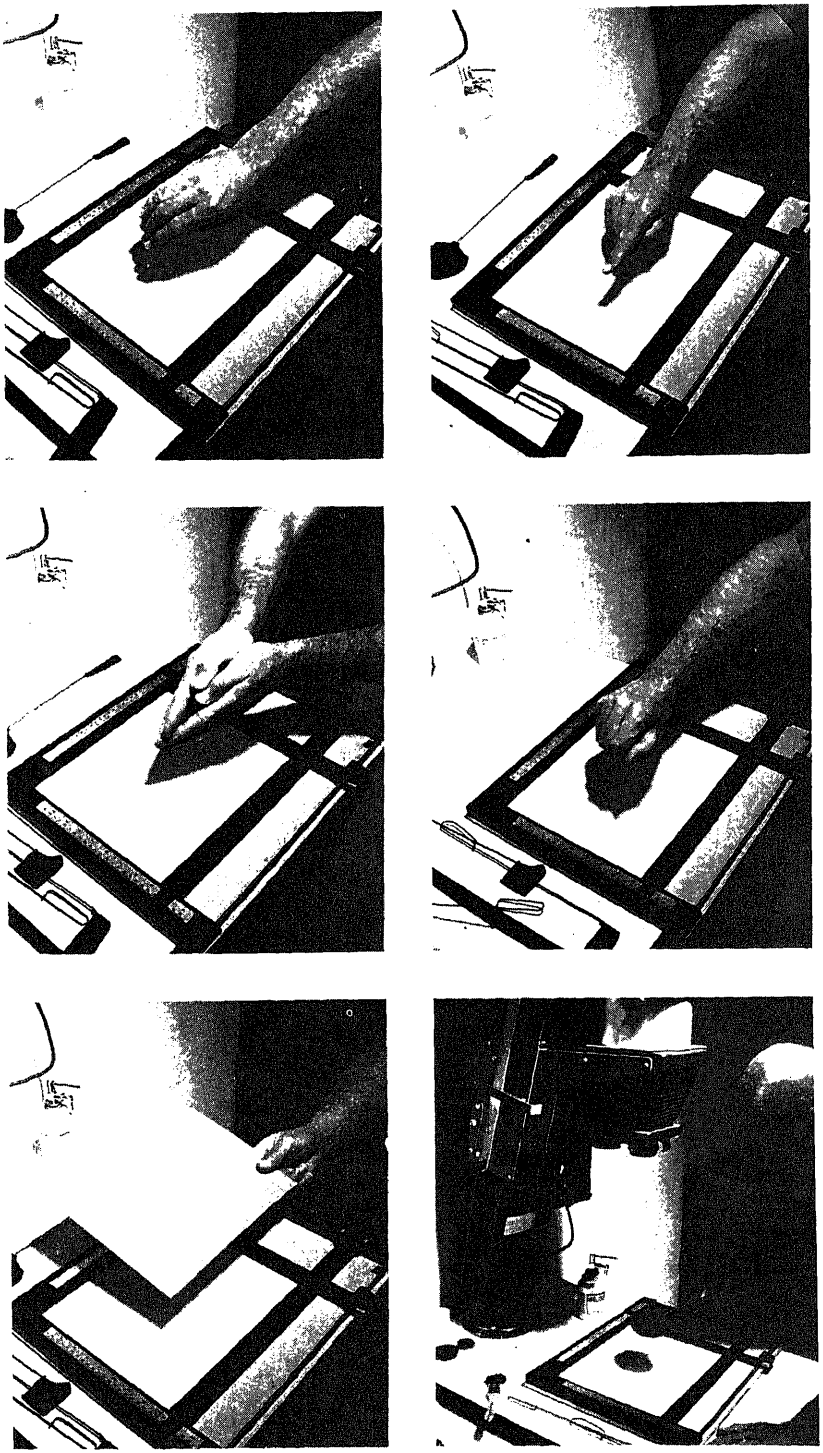
Remember, in order to prevent any distance outline of the dodging tool from reproducing in the print you must keep the dodging tool in constant motion during the exposure. Use a circular, sideways, or shaking motion or a combination of the movements.

Printing In

Printing in makes an area within a print darker than it would have printed if exposed the same as the rest of the print.

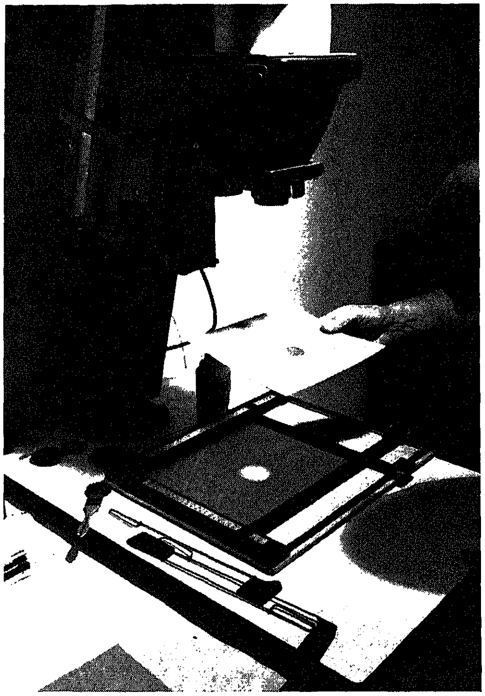
A printing-in tool is usually a piece of cardboard with a hole in the center that is smaller but approximately the same shape as the area to be printed in. Or your hand, shaped to form a hole through which the light passes, can be used.

A printing-in tool is positioned between the enlarger lens and the prnting paper so that light passes through the hole and exposes only the part of the paper you want to print darker. The



Holding back exposing light with dodging tools.

rest of the image is blocked by the tool or your hand.



Printing in or burning in to darken an area in a print.

For printing in, the usual procedure is to give the printing paper the overall required exposure, during which time any required dodging is performed. Then position the printing-in tool and reexpose the area to be darkened through the hole in the tool.

Some areas of a negative which may require printing in are the dense areas which would otherwise reproduce as pure white with little or no detail or very light gray in the print. For example; a bright sky, a white uniform or a white cake, or highlights on a face, etc.

As with dodging, in order to prevent an outline of the tool from reproducing, you should keep the tool in constant motion during the printing-in exposure.

Vignetting

In printing, vignettiang is a technique by which the printing illumination is controlled to cause the image to fade gradually into the background toward the corners of the print.

A vignette effect can be produced by projecting the desired negative image area through a large hole cut in a piece of cardboard or by dodging the central image area during part of the exposure time thus burning in part of the background. When the background is to be printed light, the entire exposure should be made through the vignetting card. If the edges of the hole are serrated, the outline of the vignette will be soft and diffused. In most cases a soft, diffused vignette produces the most pleasing result.

Head and shoulders portraits are usually the most suitable for vignetting, although vignetting may be applied to other subjects. A photograph with a light background yields the most pleasing vignette results. For a head and shoulders portrait, the vignetting card should have an egg-shaped hole cut in it. The subject in a vignette should be a little smaller than it would be in a straight nonvignetted print. Leave plenty of space around the image. Balance the head and shoulders image on the paper by leaving more blank paper below the image than above it. The blank paper at the sides should be about equal, but less than at the top.

As with dodging and printing in, the vignetting card must be kept moving during the exposure.

Diffusing

Photographs may be diffused so that sharp lines of the image are softened or subdued or blurred slightly in the reproduction. Diffusion can be used to produce a hazy effect, such as may occur on a lake in early morning. In printing portrait negatives, diffusion can be used to subdue the reproduction of facial blemishes or wrinkles. The effects of harsh portrait lighting or retouching may also be softened by the use of diffusion.

The best diffused enlargements are made using a glass diffusing disk placed under the enlarger's lens. Other suitable diffusing materials are transparent cellophane, either smooth or wrinkled, or a piece of lady's pantyhose, or similar fabric. Dark gray or black is preferable.

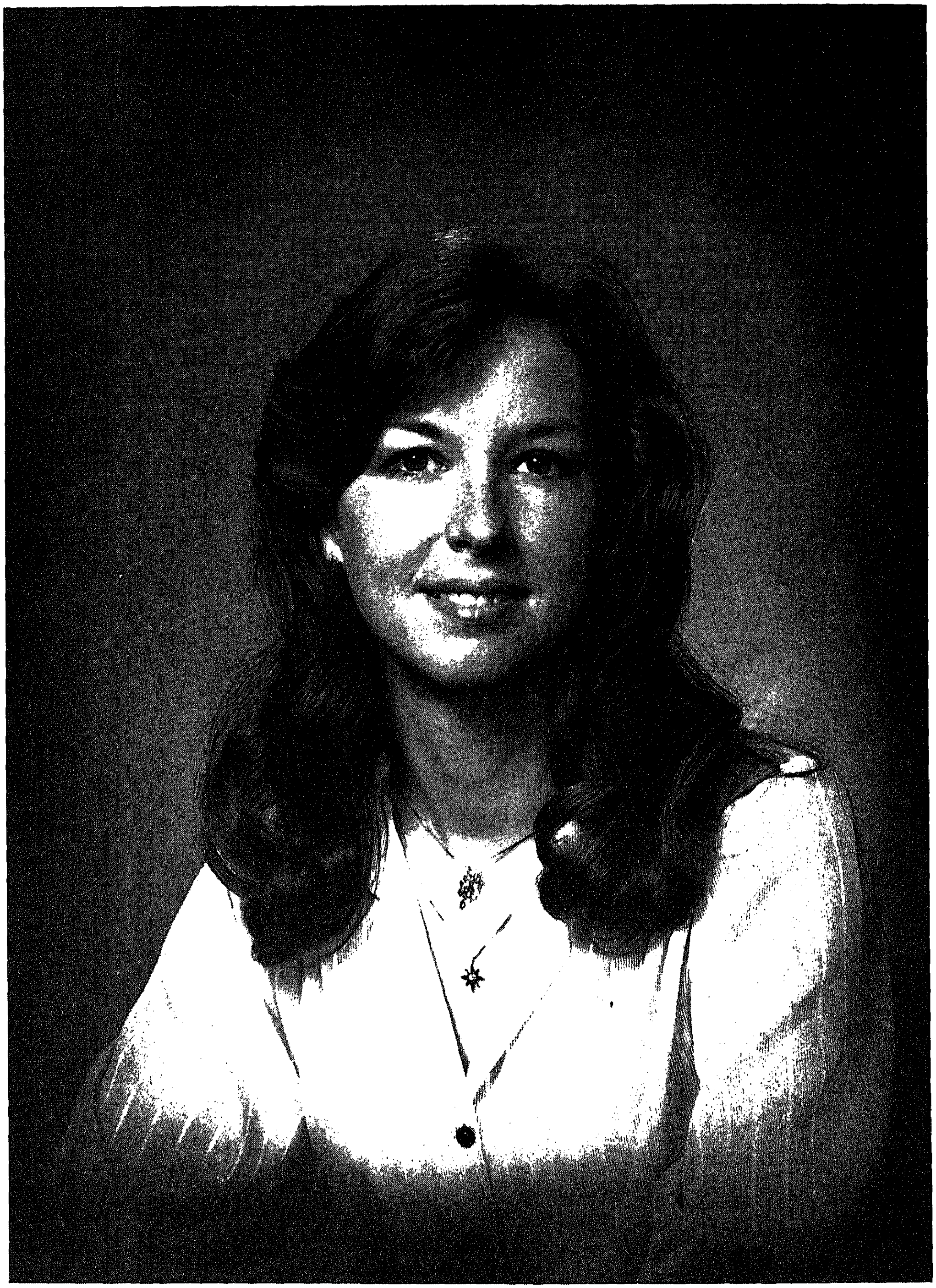
The amount of diffusing with a given material is controlled by the distance of the material from the lens of the enlarger and the density of the diffusing material.

Diffusing tends to lower image contrast; therefore, it may be necessary for you to use a higher contrast printing filter than would normally be required for a given negative.

The exposure through the diffusing material should be for about one-third the total required exposure time.

PH1 Anthony Contos USNR/R; *ANRICK Photographers, Pensacola, FL.*

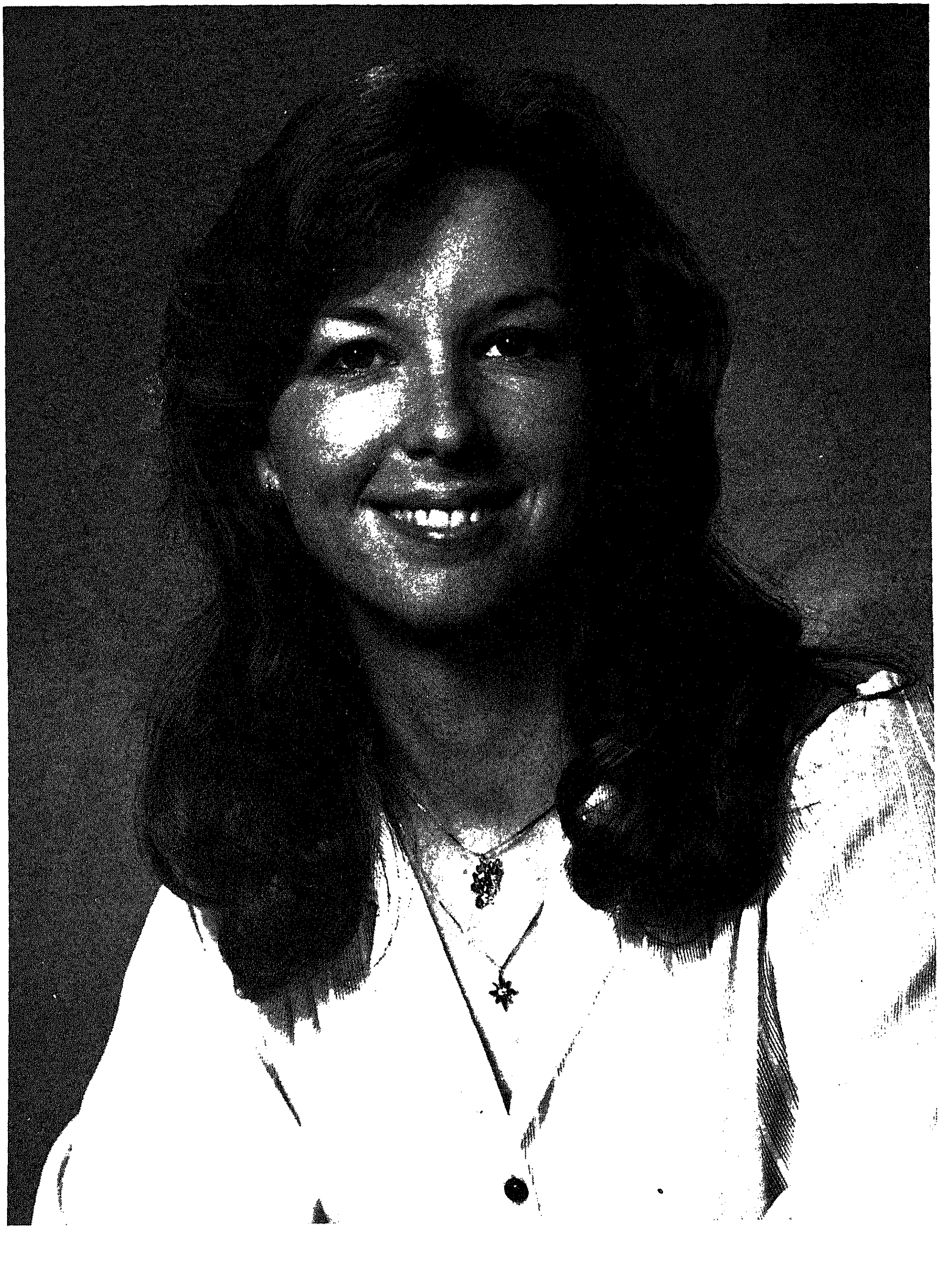
Diffused vignetted portrait of Mary B. Gehbauer.



PH1 Anthony Contos USNR/R; *ANRICK Photographers, Pensacola, FL.*

PH1 Anthony Contos USNR/R; *ANRICK Photographers, Pensacola, FL.*

Diffused portrait of Mary B. Gehbauer.



PH1 Anthony Contos USNR/R; *ANRICK Photographers, Pensacola, FL.*

In order to use dodging, printing in, vignetting, and diffusing effectively, you should make one full straight (uncorrected) print using the basic exposure determined with your test strips. Study this print and make your plan as to where you are going to dodge, print in, etc. The application of these techniques may appear time consuming; yet they make it possible to turn out prints that are rich in detail and mood—professional quality prints.

MINIMIZING GRAININESS

As you know, all photographic images are made up of fine grains of silver of various finite size. Because of this silver grain structure, enlargements, especially large ones, may appear "grainy." The graininess of a print is a direct result of the graininess of the negative and the degree of enlargement. The graininess of a print, however, may be modified to a limited extent during the printing stage by the following techniques:

- Where negative graininess is serious and would be objectionable in the print, a diffusion enlarger should be used.
- The appearance of graininess in the print can be lessened by using a rough surface paper vice a smooth glossy paper.
- A diffuser used between the enlarger lens and the printing paper will help subdue the appearance of grain. Crumpled cellophane, fine mesh screen, or a piece of nylon stocking, etc., can be used as a diffuser.
- The enlarger can be set to project an image which is slightly out of focus.

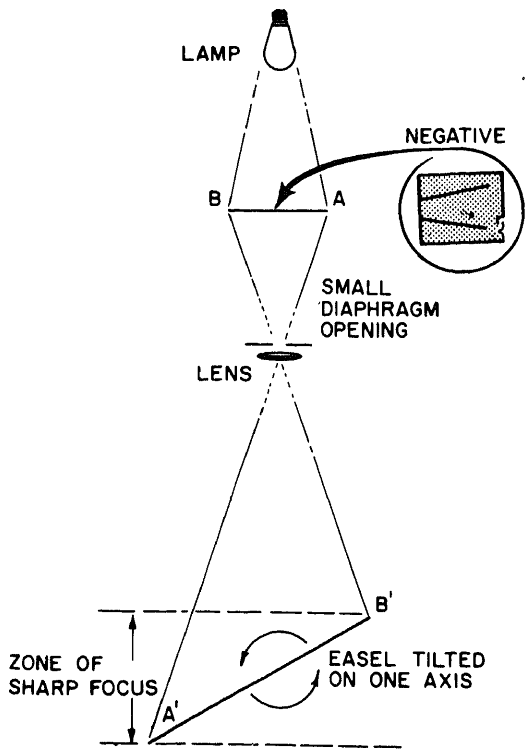
The permissible graininess in a print depends very much on the viewing conditions. For a large display print that will be viewed from a relatively great distance, more graininess can be tolerated than with a smaller print that will be held in the hand for viewing.

DISTORTION CONTROL

As you know, when you tilt your camera upward to make a picture of a tall building, the vertical lines converge and the building walls seem to be at the point of collapsing.

A view camera is equipped with movements that permit making the film parallel, or nearly so, with the subject, in spite of the viewpoint. However, most of the negatives you print probably won't have been made with a view camera, and as a result, many will show an undesirable noticeable convergence of lines. Changes in these images can be made by manipulation of some enlargers or the easel and paper to achieve image distortion correction.

Almost every enlarger has an easel that is separate from the enlarger. Because the easel is separate, it can be tilted, even if it is merely blocked up on one end. A small diaphragm opening is used to increase the zone of sharp focus or depth of field sufficiently to include both the part of the easel nearest the lens and the part of the easel farthest from the lens. Within the limits of what you can keep in focus you can correct some or all of the distortion. Some enlargers permit some tilting of the negative carrier by propping up one side with one or two coins.



Distortion correction by tilting easel.

One of the big disadvantages of tilting the easel is that an extremely small diaphragm opening must be used to have sufficient depth to the zone of sharp focus. The use of a small diaphragm opening makes focusing and composition difficult and, in addition, makes it necessary to use very long exposure times.

COMBINATION PRINTING

Combination printing is the combining of two or more negatives into one picture. How often, for example, have you taken a scenic shot that you thought was a real beauty, only to find when it was printed that you were disappointed because the sky didn't have any clouds and thereby looked lifeless? This and other similar problems can usually be solved by using more than one negative to make the print.

The hardest thing about combination printing is not technical or mechanical—it is mental. That is, deciding which negatives can be used together to make the best print.

For our example and discussion of combination printing, let us assume that we have chosen several cloud negatives to consider combining with a foreground subject negative. To begin with, you should first make a full size print of each individual cloud negative and the foreground negative. It will be much easier to make the final selection of the negatives if you have full size pictures.

Matching the Negatives

After viewing the full size prints and deciding which two negatives you are going to use to make the combination print, determine the contrast of the selected negatives. They should correspond sufficiently for them to print with snap and vigor on the same piece of printing paper. Even when using variable contrast paper, it's a good idea to use two negatives with the same contrast characteristics, thus avoiding the need to print the two negatives with different filters.

Once you have selected your two negatives, you will need the following materials before you really get started:

- Scissors or a razor blade.
- A hard and a soft pencil.
- Several thin sheets of opaque cardboard which will be used for cutout masks. These cardboards should be a little larger than the size of the print you are going to make.
- An outline guide, which is nothing more than a sheet of white paper the same size as the print you are going to make. (The back of an old print will serve well.)
- An easel or printing frame.

Making a "Blueprint"

The first step is to project the foreground negative image onto the outline guide in the easel. With the enlarger's lens wide open, adjust the size of the image until it covers the area you want and the approximate composition of what you desire. After you are satisfied with the approximate composition, focus the image, but don't stop the lens down yet.

With the hard pencil, make an outline of the foreground image onto the outline guide. After outlining the foreground image, record the enlarger magnification settings and remove the foreground negative.

The same procedure is then followed with the cloud negative. Its image is traced onto the same outline guide. Try to fit the composition of the clouds with the outline of the foreground image. If you are lucky, the cloud negative uses the same enlarger magnification settings. But of course you probably won't be that lucky, and it may be necessary to readjust the enlarger height so that the cloud negative gives acceptable composition. You may also have to move the cloud negative around in the enlarger and/or move the easel around. It may even be necessary to reverse the cloud negative—or to print it backwards so to speak.

Once you have the desired composition, outline the important cloud formations on the outline guide. You now have your first "blueprint" of the proposed combination. If this blueprint needs further refinement, and it usually does, it means removing the cloud negative and going back to the foreground negative—and back to the cloud negative—and making new outlines until you are satisfied with the results. When you are finally satisfied with the setup, darken the pencil outline. The dark pencil outline blueprint is kept intact for later use in repositioning the two negatives.

Make Test Prints

Using the outline or blueprint to establish the correct size, make a test print of the foreground negative. The exposure time, f/stop, filter number, and any local print control necessary to produce a good print are recorded. Repeat the procedure with the cloud negative. This is where variable contrast paper comes in handy. With it and the filters, you can change contrasts for the two different negatives, whereas with graded paper you would be stuck with only one contrast grade.

Making the Cutout Masks

Make the cutout masks by placing opaque but pliable cardboard over the outline guide on the easel. Project the foreground negative image onto the card and outline it with the hard pencil. With sharp scissors or a razor blade, cut the cardboard into two parts following the pencil outline (don't cut the outline guide). Mark the lower section "foreground mask"; the top section can be marked "cloud mask."

Making the Combination Print

When everything is ready, put the foreground negative back into the enlarger and adjust the magnification and focus to correspond with the outline guide, but don't disturb the position of the easel. Take a full sheet of unexposed paper (the white lights should be off), and on the back, mark one side "top." Place the enlarging paper in the easel in the same position which was occupied by the outline guide. Hold the top section or "cloud mask" cutout near the paper in such a manner as to fit the image area to be occupied by the cloud image. Turn on the enlarger and make the foreground exposure to coincide with your good foreground test print.

What you are doing is actually dodging the light that would otherwise expose the area to be occupied by the clouds. In all combination printing, success or failure depends on your ability to blend the two negative images together. Deliberately moving the cloud mask so as to allow a small amount of light from the foreground negative to spill over into the area where the clouds will be avoids a strong white dividing line between the two image areas. Thus, by allowing the negative images to encroach *slightly* into each other's area, the telltale white line where the two images join is eliminated, and the images blend.

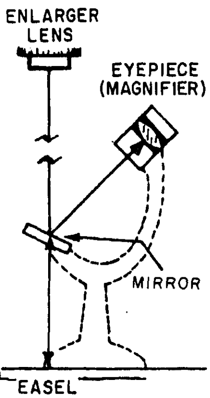
After giving the foreground proper exposure, dodging, printing in, etc., swing the red filter of the enlarger into position under the lens. Using a soft pencil, make a few identifying marks on the printing paper in the easel. These marks are only temporary and will have to be rubbed off with your fingers when the print first goes into the developer. These identifying marks must be placed *inside* the boundary lines of the foreground exposure. If the marks (usually very small dots) are on an area of the paper which has not been exposed, they will prevent light from reaching the emulsion and when rubbed off will result in white spots in the finished print.

When the identification marks have been made, turn off the enlarger light and place the enlarging paper in a box or paper safe. Put the outline guide back in the easel, remove the foreground negative and replace it with the cloud negative. Adjust the enlarger to the proper cloud magnification and focus as indicated by the outline guide. Next, turn off the enlarger light and remove the outline guide without disturbing the position of the easel. Place the partially exposed enlarged paper back into the easel, being sure the side marked "top" is in the right position. Now hold the "foreground mask" over the area of the paper which represents the foreground. The exact area is indicated by the very light identification marks you made previously. Now expose the cloud portion of the print. Again, blending is easier if you allow a certain amount of the lower portion of the sky or cloud image to overspill into the foreground area. After giving the cloud area proper exposure, develop the print and examine it. You may have to make several attempts before you get a print to your liking.

GRAIN FOCUSER

Focusing the negative image on the enlarging paper can be difficult when the negatives are dense or have no sharply defined detail you can see in the projected image.

Focusing is often easier and more consistent when you use a *magnifier* or grain focuser. A grain focuser magnifies the negative grain structure on the order of 10X to 25X, which permits you to examine or actually focus the grain structure of the image, thus providing you with



GRAIN STRUCTURE

The projected image of the negative is reflected by the mirror of the grain focuser to the eyepiece. The distance from the mirror to the eyepiece is equal to the distance from the mirror to the easel, therefore, when you see a sharp image of the negative's grain structure in the magnifier, the image projected on the easel is equally sharp. The area of the negative visible in the magnifier is extremely small and you are not actually looking at details of the image but at the grain structure of the negative that actually produces the image.

the sharpest focus you can get from a given negative. The principle of a grain focuser and the pattern you see through the eyepiece of the focuser are shown in the illustration.

For a grain focuser to work properly, it must "read" a central portion of the projected image. The best results are obtained when the focuser is used to examine a fairly opaque area of the image, one that would be a highlight in the finished print.

To use the grain focuser, enlarge and compose your picture on the easel in the usual manner. Place the grain focuser on the easel, which has a sheet of focusing paper in it, so that a central portion of the projected image will be reflected from the grain focuser's mirror into the eyepiece. Examine the grain structure through the eyepiece and adjust the fine focus knob of the enlarger until the grain structure is in absolutely sharp focus.

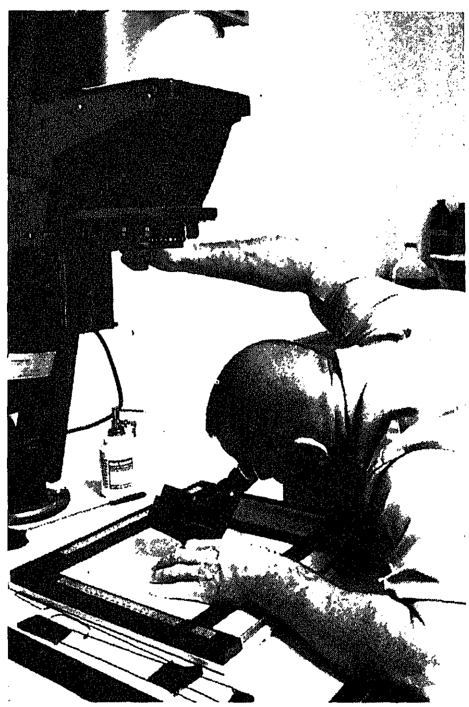
PRINT FINISHING

Print finishing begins with washing the prints and includes such other procedures as drying, sorting, spotting and retouching, captioning, dry mounting, etc.

WASHING

The purpose of washing prints is to remove the residual chemicals that remain in the emulsion and base of the paper after development and fixation. Washing dissolves and dilutes the soluble products and eliminates them with the disposal of the wash water. Thorough washing of prints is as necessary as thorough washing of negatives. If processing chemicals remain in the paper they will discolor and ruin the print.

Although chemicals diffuse from both the base and emulsion of prints during washing, it is necessary to wash *non*resin-coated or fiber base prints for a longer time than is required for films or resin-coated (RC) prints. Fiber base prints are washed longer because fibers of the paper absorb more chemicals than a film base or an RC paper base. And likewise, the nonresin-coated papers have a greater tendency to retain the absorbed chemicals. Nonresin-coated papers are usually washed anywhere from about 30 minutes for light- and single-weight papers, to about 60 minutes, for heavy- or double-weight papers.



Because most Navy photo labs are almost exclusively using RC papers, further discussions of paper in this chapter will be referring to RC papers.

Resin-coated papers should be washed in clean freshwater at about 65° to 75°F. Interleaving prints in the wash tray frequently or using an automatic tray siphon are efficient means of washing in trays. Mechanical washers may also be used where large volumes of prints are washed.

Never overwash RC prints. Overwashing can result in water penetrating the edges of the paper which in turn results in uneven drying and print curling.

Proper print washing depends on the following factors:

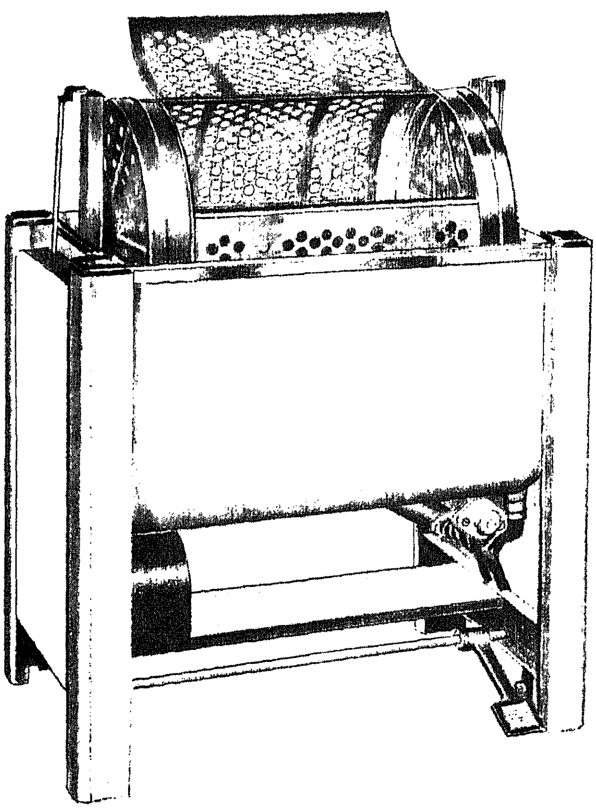
- Proper Fixing. Using partially exhausted fixing baths that require longer than normal fixing times will require longer than normal washing times.

- Temperature of the Water. The higher the water temperature, the faster the chemicals are diffused. Therefore, you get faster washing times at 75°F than at 65°F.

- Method of Washing. Whether you are using trays or mechanical washers affects the washing rate.

- Rate of Water Exchange. The number of complete changes of water to ensure that the contaminated water is being completely drained away is important. One change every 5 minutes is recommended to ensure proper washing.

- Amount of Agitation. Agitation is essential to ensure the free flow of water around each print. The prints must be rotated by hand or tumbled by mechanical means so that each print is adequately washed.



DRYING

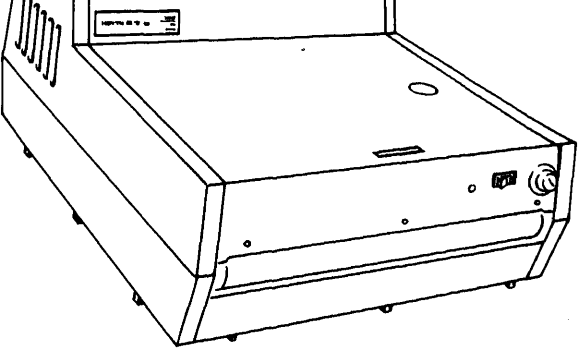
Drying is an important step in the production of prints and as such should not be treated lightly.

When washing is complete, the prints may be dried by a convenient means. Resin-coated paper will air dry readily. RC prints may be hung up to dry, much in the same manner as negatives, or placed emulsion side up on open drying racks. Forcing warm air over the prints will hasten drying. Air temperatures hotter than 190°F should not be used to dry RC prints.

Resin-coated papers may also be dried on double apron drum dryers at temperatures below 190°F, but marks due to contact with the aprons may result. When drying RC paper on a double apron drum dryer, place the prints on the apron so that the emulsion will be away from the drum.

Single apron drum dryers should not be used to dry RC paper, nor should RC paper be ferrotyped.

Hot air impingement dryers are usually used



Hot air impingement RC print dryer.

No matter what method is used to dry prints, the following recommendations should be followed for trouble-free drying:

- Remove surface water with a squeegee or a clean sponge or cloth.

- Do not dry prints at temperatures higher than 190 °F.

- Keep damp prints apart and don't allow the damp emulsion to come into contact with any material.

- Always follow both the paper manufacturer's and the dryer manufacturer's instructions when drying prints.

SORTING, CHECKING, AND CAPTIONING PRINTS

As soon as the prints are dry, examine them for defects or other unsatisfactory qualities. Trim the borders of any prints that require it and sort all prints into groups according to the negatives and job orders. Ensure that enough good quality prints are available to complete the order. Negatives that need additional prints or reprints should be sent back to the print room for the required prints. Remember, you have a responsibility to ensure that only prints of highest quality are placed with job orders for delivery to the requester.

be disposed of in accordance with instructions contained in *Department of the Navy Information Security Program Regulation,* OPNAVINST 5510.1. Rejected prints from negatives which are not classified should be disposed of in accordance with local instructions, which should be geared toward silver reclamation.

All prints made from file negatives should be fully captioned and marked on the back with identification information. For information on writing captions for photographs, refer to module 2 of this rate training series and OPNAVINST 5290.1.

The means of applying the caption and identification information to the back of prints may vary from lab to lab, depending on the requirements and resources available. Writing on the back of prints should be avoided if at all possible. If handwriting is the only means you have for captioning and applying identification information, you should use a soft lead pencil and write lightly. Excessive pressure when writing on the back of a print can cause visible defects in the form of raised surfaces on the face of the photograph. A nonwater base, fast drying ink, felt tip pen such as a Sanford Sharpie is recommended for writing on the back of RC prints. Classified photographs must be marked with the appropriate classification as specified in OPNAVINST 5510.1.

PRINT MOUNTING

For exhibition and display, prints are usually mounted on a stiff board which sets off the picture by a broad border, and also protects the edges of the print itself against damage.

When preparing a print for exhibition or display, the objective is to show the print to best advantage. Simplicity is essential in doing this. Any elaborate artwork, such as colored borders or fancy lettering, often detracts from the main point of interest which, of course, is the print.

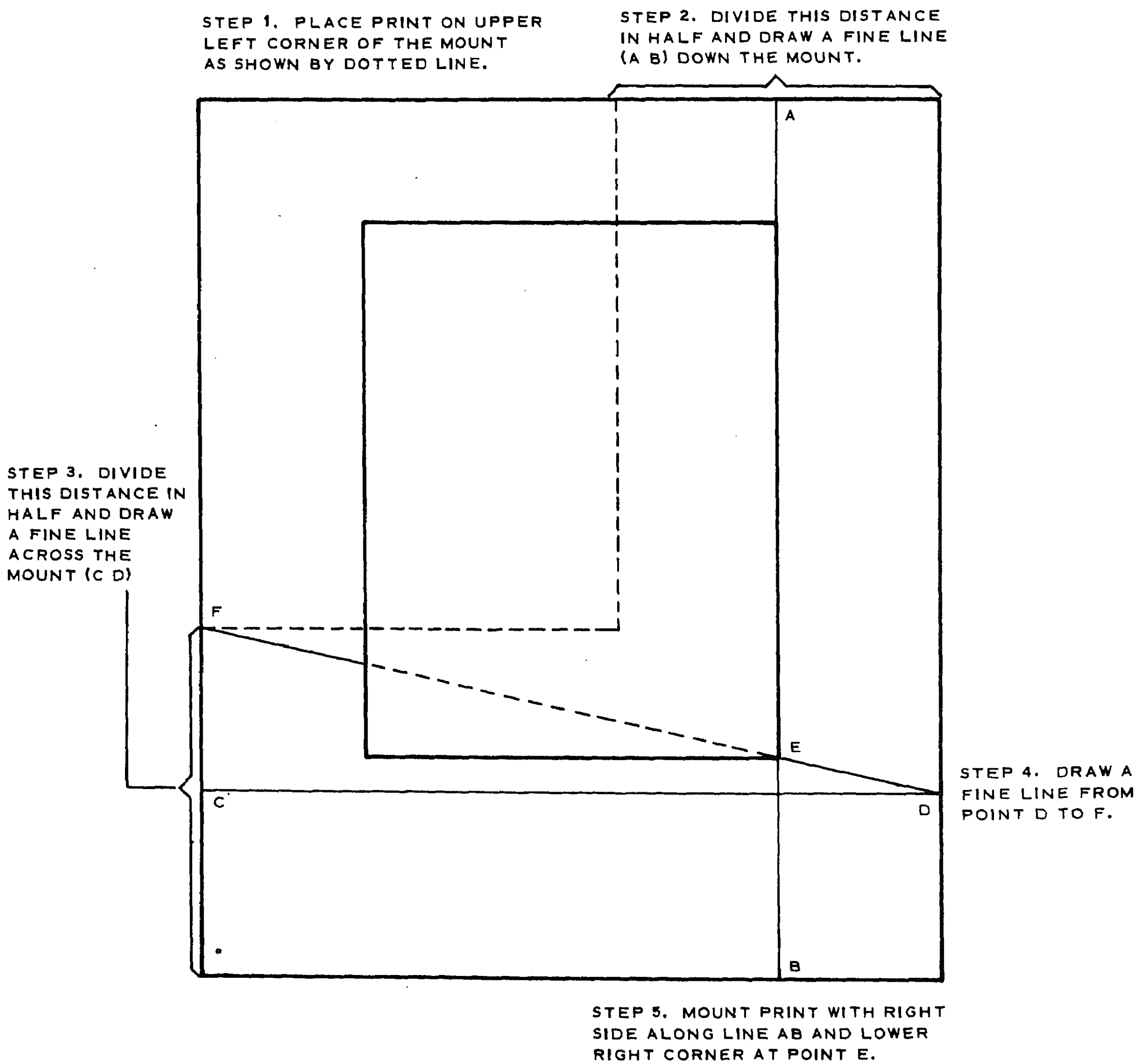
Prints for display purposes are generally mounted on special cardstock to make them stand out from their surrounding. The cardstock is available in various sizes, colors, textures, and weights. And while no definite rule can be given,

a mount should be used which compliments the print. The mount should be large enough to balance and amply support the picture, while the texture and color should lend themselves to the overall tone. For instance, a buff or cream colored, pebble grained board would probably do more to enhance a sepia toned landscape scene than would any other color or texture of mounting board.

The placement of the print on the mounting board is of utmost importance. Prints mounted at queer angles or in a corner of the mount are not generally acceptable. The prints should be placed on the board in such a manner that the top and side borders are equal. For good balance, the bottom border should be about one-third wider than that of the top and side borders.

Adhesives

The adhesives used for mounting prints are of two types: wet or dry. The liquid adhesives generally used are rubber cement and spray-on adhesives. When you are using gum arabic, glue, or paste, it is almost impossible to prevent some staining or smearing of the mounting board around the edges of the print. Rubber cement and



Proper location of print on mount.

spray-on adhesives are the easiest and cleanest to use. After it has dried, excess rubber cement or spray-on adhesive can be removed by lightly rubbing it. There will be no damage to the print or mount if a good grade adhesive is used. However, rubber cement and spray-on adhesives are not permanent, and in time the print may loosen and peel off the mount. In this case the print must be remounted with fresh adhesive. Rubber cement makes an ideal adhesive when prints are to be temporarily mounted for display purposes or for copying.

For a temporary dry mount, you can use double-sided self-adhesive tape. Length of this may be applied to the edges of the print, or shorter pieces to the four corners. The protective backing of the tape is then stripped off, and the print is placed in position on the mount.

For a permanent bond, you can use pressure sensitive adhesive sheets that require no additional equipment or heat. To use this material, you simply peel off one side of the protective sheets and apply to the print. Then peel off the protective sheet on the other side of the material and mount the print in place.

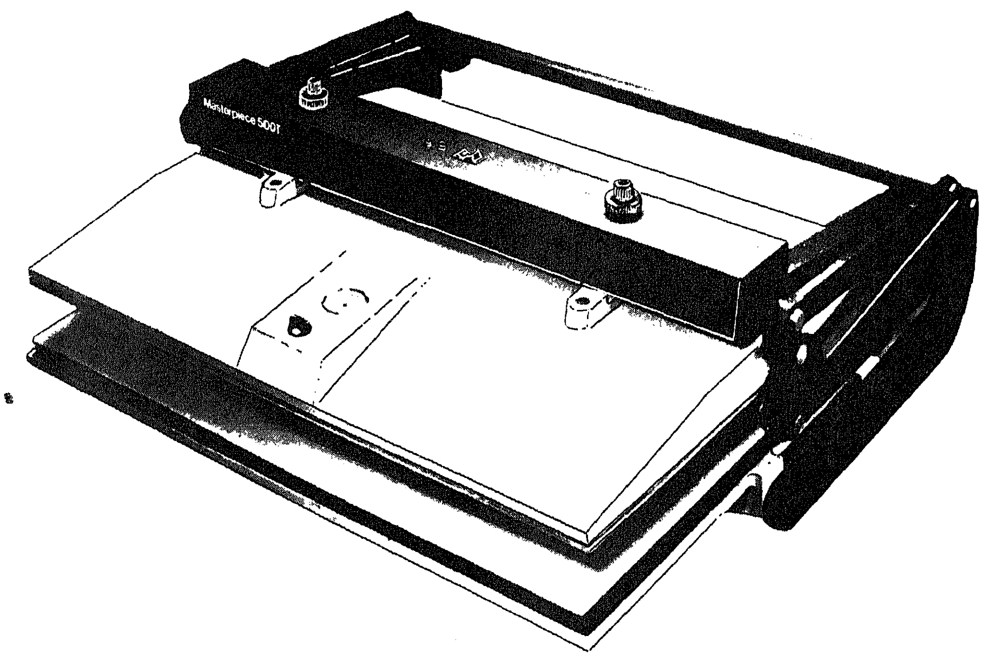
The traditional method of dry mounting prints is done by using dry mounting tissue; i.e., a tissue paper, coated on both sides with a shellac or plastic type of adhesive. The tissue is dry, thin, not sticky, and easy to handle. Furthermore, it is odorless and chemically inert so that it will not stain a print. Being moistureproof, it gives a strong, flexible, and permanent bond between print and mount. The dry mounting process is so clean, simple, and efficient that it is by far the most widely used process in the Navy.

Dry Mounting Press

The dry mounting press is an efficient and simple implement for providing attractively mounted photographic prints. Heat is used to fuse the dry mounting tissue between the print and the mounting surface.

A dry mount press is designed to provide uniform heat and uniform pressure. The press must be kept in top condition. A press that is not will produce less than perfect mounting results.

Traditionally, mounting tissues such as Seal's MT5 are activated by heat and require specific temperatures for best general results. You should



Courtesy Seal Inc.

operate your dry mounting press at the temperature suggested by the manufacturer of the press and/or the mounting tissue or adhesive. Keep in mind, however, that a slightly lower heat level is better than too much heat. Incomplete adhesion through slightly lower temperatures can be easily overcome by leaving the work in the press for a longer time.

Your dry mounting press should be adjusted to apply the correct pressure in mounting applications. Pressure is an important component of good dry mounting. While you do not need a lot of pressure, you do need *uniform* pressure—usually about 3 - 5 psi. Proper pressure adjustment and a resilient sponge pad are essential.

Adequate pressure helps squeeze out air from between the adhesive and mountboard, and adhesive and print. This ensures good, intimate contact between the board, adhesive, and print.

TIME.—The time period required to make a good bond is the one factor that varies most when using a dry mounting press. Generally speaking, the correct time period is the amount necessary for the press to squeeze out air and moisture from the work and to allow heat to travel through the various materials to activate the adhesive and complete the bond. Because different material thicknesses and/or heat conducting characteristics require different mounting times you may have to experiment with the various materials to arrive at the required press time. Most people, however, have a tendency to remove the work from the press too soon. However, you can replace the work for a second time period if sections of nonadhesion are noted.

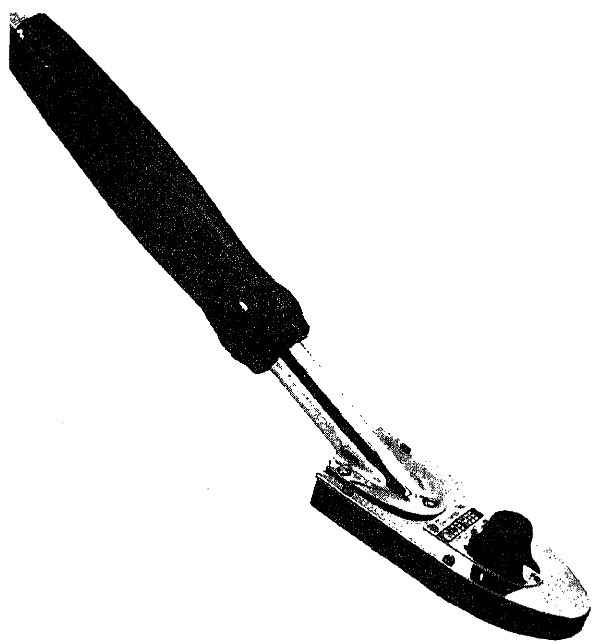
HUMIDITY.—All porous paper materials such as photographic prints and mounting boards absorb moisture from the air. Moisture in the form of vapor can become trapped between the various layers of dry mount materials and cause blisters and bubbles in the finished work. For best and most consistent dry mounting results most prints and mountboards should be pre-dryed before mounting applications. Some nonporous materials that should not be pre-dryed are Cibachrome prints and foamboards.

Dry Mounting Procedure

When using dry mounting tissue, place the untrimmed print face down on a table. Fasten a sheet of mounting tissue as large as, or larger than, the print to the back of the print by applying the point of a hot tacking iron very lightly at one or more points, depending on the size of the print. Turn the print faceup and trim both the print and tissue together. This ensures that the print and the tissue are exactly the same size and shape, with no overlapping edges. Position the print on the mounting board, and tack the print to the board with the point of the hot iron. Make sure, however, that the print is covered with a protective sheet of clean paper before applying the hot iron.

The dry mounting process is easy and requires few operational steps. Before doing any actual mounting, prepare the press and dry a cover sheet to be used to protect the print in the press. A piece of heavy paper; a smooth finish, medium-weight cardboard; or a photographic blotter works well as a cover sheet. Place the cover sheet on the press pad and bring the heated platen into contact with it. Allow the platen to remain down for a minute or two to remove all traces of moisture from the cover sheet. Follow this procedure whenever there is a possibility that the cover sheet has absorbed any moisture from the air.

Holding the trimmed print in the desired position on the board, slip the tacking iron



Courtesy Seal Inc.

Tacking iron.

between the print and the mounting tissue, tacking the tissue to the board in at least two places. The tacking holds the print in position so that it will not move when it is being put into the press.

Place the print and board on the pad in the press so that the print face is up. Cover the print and mount with the dry cover sheet.

Apply pressure and heat by lowering the heated platen and locking it in the down position. After 20 to 30 seconds, release the pressure and remove the print. For best results, all materials should be cooled under a weight immediately upon removal from the press. This assures that the bond has an opportunity to set. To test for permanent adhesion between print and mount, *allow the print to cool* and then bend the mount backward slightly away from the print. If the print does not adhere to the mount, a further application of heat is necessary.

The amount of heat applied to a print is important. Insufficient heat does not adequately fuse the adhesive to the print and to the mount, and the print may peel away from the mount. Too much heat melts the adhesive and allows the paper of the print and the paper of the mount to absorb it. As a result, the bonding between the print and tissue and between the mount and tissue is not good enough to hold the print. Since the mounting time varies according to the conditions and materials, you can determine the correct amount of time to apply heat only by practice and tests.

To mount prints larger than the platen, make several impressions by moving the print so that each portion receives an equal application of heat and pressure.

Remember proper safety precautions when you dry mount prints. Tacking irons and presses generate high temperatures which can cause serious burns. Be careful when you use these tools and do not leave them unattended. When you are finished, unplug the equipment and leave a "HOT" sign to warn your fellow workers of possible danger.

When mounting prints you will also be using paper trimmers. As a final safety warning, remember to watch your fingers when you are cutting, and to leave the trimmer blade properly latched down when you are finished.

PRINT SPOTTING

All the tiny flaws in the negative, such as scratches, adhering dust particles, and pinholes, are reproduced in the print. The greater the degree of enlargement, the more obvious such defects become.

Prints are spotted to eliminate white or gray marks caused by dust, lint, and other similar particles which may have adhered to the negative. Black spots may be caused by minute defects in the negative's emulsion such as pinholes. All print surfaces from glossy to dull matte may be spotted. Spotting is also done for the purpose of correcting or toning down certain areas, such as highlights, which appear too bright in a print.

Tools

To do print spotting, it is a good idea to have a clean, well-lighted working space. Light should come from the left (from the right if you are left-handed) or from behind you. Light coming from above or from in front of you causes disturbing reflections on the print. You should have a workbench or table to work on. It is also a good idea to have a variety of tools close at hand. The following is a list of the major tools and supplies you should have available.

- *Spotting colors*. There is a variety of spotting dyes or water colors that are either liquid or cakes which can be mixed and diluted with water to achieve tones that match the spot to the surrounding areas.

- *Small water glass*. To mix the colors, you need a small glass to hold your water.

- *Brushes*. A good selection of sable brushes is needed to apply the spotting colors.

- *Photo blotters*. Good photo blotters are helpful to wipe up any excess moisture on the prints.

- *White paper*. White paper is used to shape the point on your brush when it is loaded with color. It also provides a good check to see that the color is exactly what you want.

- *Lead and carbon pencils and crayons*. A good selection of pencils of different hardness is essential. Carbon pencils are useful for spotting matte prints. Artist-type crayons can also be used for spotting.

Courtesy Kreonite, Inc.

Photofinishing station.

● *Sandpaper*. Sandpaper is helpful in keeping your pencils sharp. Use a fine grade sandpaper or emery cloth.

● *Etching knives*. An etching knife can be used to cut away or tone down dark spots.

Spotting Techniques

Spotting takes practice and patience. After doing it for several hours you will want to *correct* the cause of the spots, rather than master the cure.

SPOTTING WITH WATER COLORS OR DYES.—Water colors or dyes can be applied to any type of print surface. With water colors the technique is to moisten the brush and stroke it half dry on a piece of white paper. Then take up the color from the cake of dry water color and turn the brush on a piece of white paper. This helps get a fine point and at the same time

Start with the darker areas first and then work to the lighter ones.

Spotting dyes, unlike water colors, are solutions. Here the dye should be diluted in the brush while the brush is semidry. The dye is applied repeatedly to the spot until the spot disappears in its surroundings.

Black spots can be corrected with white colored dyes which then can be blended to cover over the spot. The easiest solution is to opaque the pinholes in the negative and then retouch the resulting white spot on the print.

The key to the use of water colors or dyes is the matching and blending of the color to match the surrounding area. Also, when you are spotting glossy prints, make sure that you use dyes specifically meant for glossy prints. Otherwise, the spotted area will look dull in comparison to the surrounding area.

SPOTTING WITH LEAD AND CARBON

few light spots. If you are retouching glossy prints you first must use a retouching fluid to provide a rough surface for the lead, etc., to hold. Unfortunately, the use of retouching fluid leaves a dull spot which may detract more from the print than the spot that is being retouched. Rougher matte surface papers accept lead and crayon. A couple of warnings are in order. Pencil lead tends to leave a bright sheen which stands out. The sheen can be dulled by rubbing it with your fingers. Another problem with crayon or lead is that there is a tendency for it to smear or to rub off with handling.

ETCHING.—The use of an etching knife to lighten dark spots takes quite a bit of skill. Once the dark spot is removed, it can be spotted with dyes or pencils as the case may be. Remember that with glossy prints you will remove the gloss, causing a dull spot.

PRINT DEFECTS

Print defects

Defect	Appearance	Cause	Prevention
Abrasion marks or streaks.	Surface of paper abraded or scratched; results in fine dark lines on the surface of the print, especially with glossy paper.	Friction or rubbing on the surface of the paper.	Store paper boxes on their edges; handle carefully; make sure that processing solutions are free from grit or undissolved particles.
Bad definition in parts of print.	Parts of print poorly defined, blurred, as if out of focus, though negative is sharp.	Buckling of paper in the contact printer, thereby blurring these parts.	Check contact pad in printer. Pressure springs should be firm and strong.
Bad definition over entire print.	Completely blurred print from sharp negative.	In contact prints, due to printing from the wrong side of the negative. In enlargements, careless focusing or, more often, vibration of the enlarger, especially at high magnification.	In contact printing, the paper emulsion must always be in contact with the emulsion of the negative. Enlargers should be firmly braced and protected from vibration
Round white (light) spots on print.	Round white or light spots in picture area.	Air bells prevent developer from working on parts of paper.	Proper agitation of print in developer.
Round dark spots on print.	Round or circular-shaped dark spots.	Air bells on surface of print in fixing bath, allows developer to continue to work.	Use a stop bath between developer and fixer. Agitate thoroughly in fixing bath.

Print defects

Defect	Appearance	Cause	Prevention
Round discolored spots appearing some time after drying.	Round discolored spots in picture area of print.	Air bells in washing prevent removal of hypo in these areas.	Thorough washing with constant agitation.
Small, well-defined brown spots.	Brown spots on front or back of print.	Particles of rust in wash water from rusty wash tanks or water pipes and/or particles of chemical dust.	Where quantities of rust are present, use a water filter in the line.
Tone of image unsatisfactory.	Greenish or muddy tone.	Overexposure followed by under-development.	Correct exposure and development.
Contrast; excessive.	Contrasty print.	Wrong printing filter used.	Use a lower number filter.
lacking.	Flat print.	Wrong printing filter used.	Use a higher number filter.
Fading.	Fading or tarnishing.	Incomplete fixing and/or washing.	Give adequate fixation and washing.

NEGATIVE DUPLICATION

Duplicate negatives are often required for distribution. There are many times when it is desirable to distribute negatives to other commands for printing or for filing and storing in different locations. At times, it may be necessary to send duplicate negatives to other bases for making prints to be used for operational, instructional, or publicity purposes. Duplicate negatives are also used when it becomes necessary to speed up production or when a large number of prints of the same subject must be produced. This can be accomplished by making a number of duplicate negatives of the original and distributing them to the various printing stations. By this method several people can be simultaneously working to meet production requirements.

Some defects in negatives can be corrected

can dodge or print in any local area of the negative. Of course, you cannot impart any detail that is not in the original.

DUPLICATION BY CONTACT PRINTING

If the duplicate negative is to be the same size as the original negative, contact printing is the easiest and most economical method. The positive negative film method is simple to accomplish. First, contact print the negative with a fine grain copy film. After the film has been processed and dried, you have your master positive. From the master positive, you repeat the same contact printing steps with your copy film and you can turn out as many duplicate negatives as needed.

To ensure good results, remember the following points:

sensitivity than the print papers that you are using. Watch those safelights! Make sure that they are the type recommended for the film. Exposure times may also be shorter than you are used to.

- Make sure that both the original (or master) and the film are clean. If you don't, you will have images of the dust spots on the film that cannot be removed.

- You can dodge, print in, or change the contrast (by exposure and development combinations) of the master positive or duplicates. But remember, your aim is to obtain printable negatives that can produce prints that are as good as or better than those produced with the original negative. Your master negative and duplicates should not normally have high contrast. They should contain a full range of tones that match the original.

- You should carefully choose your film/developer combination for each step. Duplication magnifies grain, and so by the time you have made your positive and duplicate negatives, the grain of the original will have been magnified. This magnified grain could ruin your prints. Keep grain down by using fine grain film/developer combinations.

DUPLICATION BY PROJECTION PRINTING

When the duplicate negative must be a different size than the original, use a projection printer. The steps in the positive/negative process are the same except that film is held in the easel. Projection printing will give you much greater control over dodging and printing in.

Reversal Film

An alternative to the positive/negative method of duplicating negatives is to use reversal film which can produce the negative in one step. The drawbacks are the limited number of black and white reversal films, and that the processing is more elaborate.

CHAPTER 5

COLOR PRINTING

The mechanics of color printing are very similar to black and white printing. Once you have mastered the techniques of black and white printing you will have a solid foundation on which to build your knowledge and skill as a color printer. The added skill and knowledge required in color printing will come with study, practice, and experience. It basically involves being able to distinguish between various, and sometimes subtle, colors and being able to select the correct filters in order to alter the color *quality* of the exposing light in order to produce a color print with proper color balance. This is not nearly as difficult as it may sound, and in short order you will be able to make excellent color prints. However, before we jump right into making those color prints it will do well for you to review the principles of color photography and see how they apply to color printing.

PRINCIPLES OF COLOR PHOTOGRAPHY

Color photography is a complex subject, however, it is also the place in photography where most people begin. Because the complexity of color photography is well hidden, so to speak, and because most people don't know much about it, it doesn't bother them. Most people just take their pictures, send the film to the drug store, and in a few days pick up their "beautiful" color prints, which, because they are in color, makes them good. And since they are entirely pleased with what they get they have no reason to investigate the complexity of the color process. Thus, they continue on in ignorance of what color photography really involves and only by coincidence produce really good color photography. However, as a Navy photographer you are a professional and in order to produce professional quality color photography you must have at least a *basic* understanding of the color process, especially if you are going to make color prints.

COLOR IS LIGHT

Any and all color you see is simply light. Where there is no light there is no color. When we "see" a colored object, what we are actually seeing is the light reflected or emitted from that object. Therefore, it is the light alone that we see and not the actual object.

The color of light we are most familiar with is white. Actually, white light is made up of all the colors, although they are impossible to see directly. When we see the white light reflected from a sheet of white paper it is hard to understand that what we are actually seeing is a mixture of all the colors of light being reflected in equal amounts. But to have an understanding of color printing you must realize this fact.

White is usually thought of as no color; however, it is more accurate to think of it as all color. With that in mind, if one of the colors is missing, the color won't be white light but a different color—green for example. If magenta (a bluish red color) is missing the resulting color is green. If cyan (a greenish blue color) is missing the color will be red, etc.

As you read this chapter and as you do color printing it may help you to think of a color as being white with something missing. That is:

- blue is minus yellow
- green is minus magenta
- red is minus cyan
- yellow is minus blue
- magenta is minus green
- cyan is minus red

Also keep in mind that:

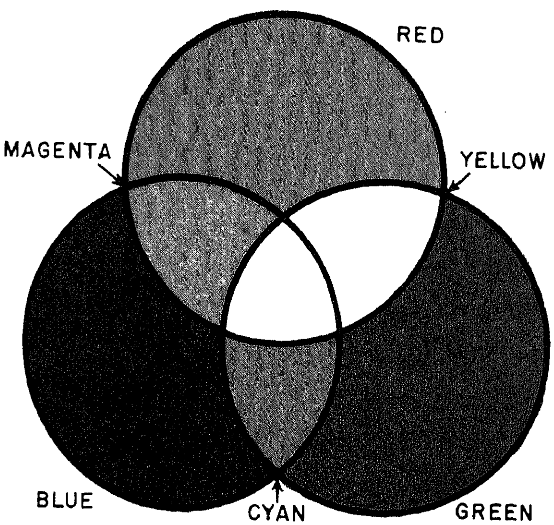
- all color is light
- white is all colors

LIGHT PRIMARIES

As you know white light is a mixture of all the colors of light. However, only three basic colors are actually needed to make white light. For now we shall call these three colors the *light primaries*. They are red, green, and blue. Not only will these three light primaries produce white light, but they can also produce any other color you want. To demonstrate this fact, imagine a blue, a green, and a red spotlight shining on a white screen in a dark room so that the spotlight circles partly overlap. There are three places where two of the light primaries overlap and one place where all three light primaries overlap. In the areas where two primaries overlap a distinctly new color is created. Thus by overlapping:

- *red* and *green*, yellow is created
- *green* and *blue*, cyan is created
- *blue* and *red*, magenta is created

In the area where all three light primaries overlap, we, of course, have white.



Mixed beams of the three primary light colors.

As you continue in your study, and in the actual production of color prints, it will help if you remember:

- yellow is greenish red
- cyan is greenish blue
- magenta is bluish red

This will help you remember the colors of light that make up yellow, cyan, and magenta, which we shall call the *light secondaries*, which means that they are the colors produced when two light primaries are mixed.

Additive Primaries

Now that you have an understanding of the light primaries, we will change their name. We shall now refer to them as the *additive primaries*. The new name simply indicates that certain colors of light can be added together to create distinctly new colors, which you have seen.

Color films and papers, as you know, have three separate emulsion layers which are sensitive, respectively, to red, green, and blue light. Because the emulsions are sensitive to the additive primaries, they will, when working together, record all colors. In the three emulsion layers, three separate, superimposed images are formed and when viewed together they give a full range of colors.

The color formation, however, is not direct. For example, in a color print a cyan image is formed in the top or red sensitive emulsion layer, a magenta image in the middle or green sensitive layer, and a yellow image in the bottom or blue sensitive layer. These three colors or dyes—yellow, cyan, and magenta—are what produce the colors we see when we view a color print. These colors—yellow, cyan, and magenta—are called the *subtractive* (as opposed to additive) *primaries*.

Subtractive Primaries

Keep in mind now, that the additive primaries—red, green, and blue—are the basic starting colors from which all other colors of light can be created. When working with *light* they produce all the other colors. However, they won't do this as dyes or pigments. For example, blue and green dyes can't be mixed to produce cyan, though blue and green light can.

For dyes and pigments, or colorants as they are called, another set of primaries is needed. This other set of primaries happens to be yellow, cyan, and magenta. Dyes or colorants are what form the colors within a color print (or film). The colorant primaries, yellow, cyan, and magenta, can be used separately or superimposed (mixed) one image over the other, to produce other colors. That is:

- magenta + yellow = red
- yellow + cyan = green
- cyan + magenta = blue

The colorant primaries—yellow, cyan, and magenta—are called the subtractive primaries because they subtract certain colors from the light falling on them.

Anything that is colored is subtracting something from light. That is, something appears to be a certain color because it is subtracting or absorbing a certain other color or colors from the light falling upon it. For example, an object which appears:

- *red* subtracts green and blue (cyan) light
- *green* subtracts red and blue (magenta) light
- *blue* subtracts green and red (yellow) light
- *magenta* subtracts green light
- *cyan* subtracts red light
- *yellow* subtracts blue light

The amount of subtraction a color is capable of depends on its hue or color. That is to say, each of the subtractive primaries—yellow, cyan, and magenta—is able to subtract one third of the visible spectrum. Each of the additive primaries—red, green, and blue—can subtract two thirds of the spectrum.

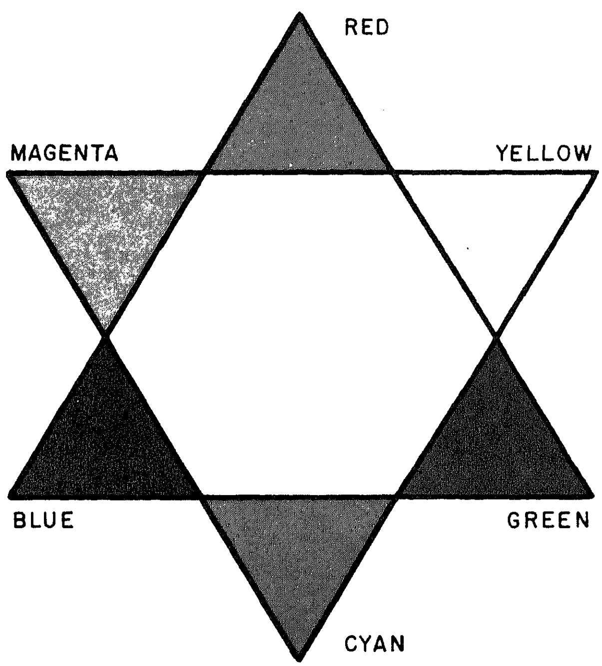
This whole idea of color by subtraction may seem confusing at first, but if you will just accept it, all of a sudden it will hit you and all become very clear. If you don't understand it now you must accept it because the whole structure of modern color photography, the *subtractive color process*, is built around it. In other words, color photography (printing) today depends on getting colors by subtraction.

COLOR STAR

In trying to understand this complex subject it will do well to make an illustration of the colors in the form of a star containing two overlapping triangles. With such a star both additive and subtractive effects can be illustrated. However, since we are concerned with the subtractive color process we shall call our star the subtractive color star.

The star is a diagram that shows how colors can be mixed. Any two primaries (colors) on opposing points of a given triangle, when mixed, will produce the color between them. For example:

- green and red = yellow
- yellow and cyan = green
- green and blue = cyan



Subtractive color star

Just as important, the color star shows the colors that will neutralize each other. These colors are called *complementaries* and are located across from each other. That is:

- yellow is complementary to blue
- red is complementary to cyan
- magenta is complementary to green
- blue is complementary to yellow
- cyan is complementary to red
- green is complementary to magenta

Thus, yellow neutralizes blue, blue neutralizes yellow, red neutralizes cyan, cyan neutralizes red, etc.

When the colorants are neutralized the result is grays or blacks and is referred to as *neutral density*. The neutral density may be either full or partial depending on the relative strengths and amounts of the neutralizing colors. For example, equal amounts of full-strength blue and yellow will produce full neutral density, whereas a weak blue and a strong yellow will yield a grayish yellow.

The information on the color star with respect to complementary colors is applied mainly to color printing by use of color filters. The filters used in color printing, either color compensating (CC) or color printing (CP), give you a way of subtracting color from the enlarger's light source before it reaches the color printing paper. In other words, the filters used in color printing alter the color quality of the enlarger's light source. For example, if it is necessary to subtract green from the light, you would use a magenta filter, to subtract blue, a yellow filter, etc.

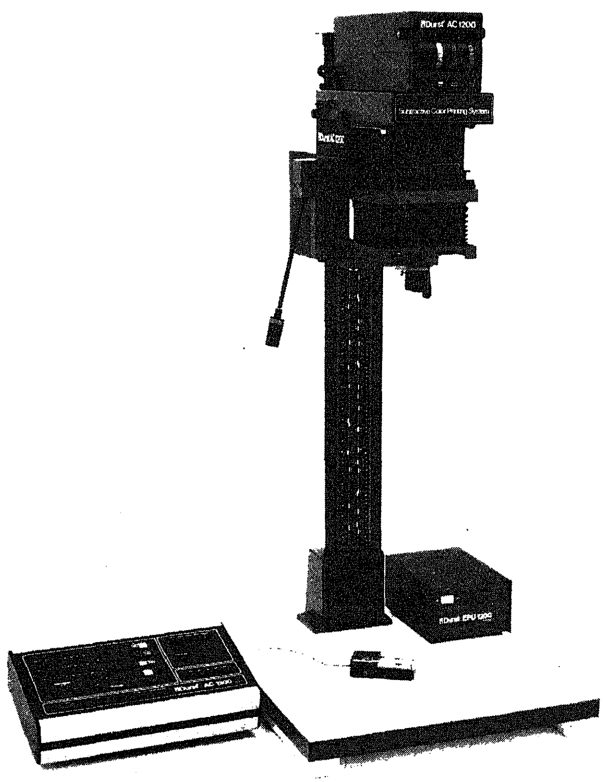
In color printing color filters are always used to *subtract* a particular color. You can find which filter will subtract a given color from the enlarger's light source by finding its opposite or complementary color on the color star. For example, if you want to subtract red from the light, find red on the star and across from it you will find its complementary color which is cyan; thus, to remove red from the light source you would use a cyan filter in the enlarger.

The foregoing part of this chapter is designed to give you a basic overview of the principles of color photography of which color printing goes hand in hand. The remainder of this chapter will give you a better understanding and insight to color printing and provide you with the knowledge you need to make good, professional quality color prints.

COLOR PRINTING EQUIPMENT

When considering the requirement for color printing equipment, you run into two of the same factors that can create problems in exposing color film in a camera; i.e., intensity and time. With color printing equipment, however, there are additional interrelated considerations, some of which are:

- the color temperature of the enlarger's light source
- the potential for using corrective filters



Courtesy Durst North American Inc.

- the accuracy of the enlarger timer
- the stability of the power (voltage) supply
- light leakage from the enlarger
- ease of operation in *total darkness*

THE ENLARGER

A good quality enlarger is essential to producing high quality color prints—as essential as a good quality camera. There are two main types of color enlargers which differ in the way they filter the light that reaches the color printing paper or material. The first and simplest color enlarger has a filter drawer between the light source and the negative. With this type of enlarger you achieve the filtration by using gelatin or acetate filters, called the filter pack, placed into the filter drawer which in turn is inserted between the light source and the negative. The second, and most common, type of color enlarger uses dial-in filtration. This type of color enlarger has three filtration controls which move yellow, cyan, and magenta filters into the path of the exposing light. The newest dial-in enlargers use an intensely bright tungsten-halogen light source and dichroic glass printing filters. Dichroic filters have an advantage over acetate and gelatin filters in that they are nonfading, shorten printing times, and speed up production. The dichroic filters (or more accurately, segments of them) are moved in and out of the exposing light beam on calibrated cams. With this type of filtration system, accurate and precise repetition of filter pack combinations is assured.

Color Temperature

Throughout our discussions of color materials and color photography we have been reminding you of the fact that the color temperature of the light used to expose the color material must match the color material's spectral sensitivity. This is true when you are making the original camera exposure, and it is also true when you are printing color materials. In color printing equipment, color temperature is usually regulated and maintained by the regulation of the voltage applied to the lamp, and by the addition of light balancing filters to the light source. If the light source in the enlarger is to be ideal for color printing, you must be able, when necessary, to change its color temperature and sustain the value once it is established.

CORRECTIVE FILTERS.—In color printing, the three emulsion layers in the printing material must be correctly exposed from the three color records (images) in the negative. The exposure of these three layers is manipulated both by exposure time and the color quality or temperature of the exposing light reaching the paper. The color or quality of the light is altered by placing color filters in the light beam of the enlarger. You can use *color printing* (CP), *color compensating* (CC), or dichroic filters.

> CP filters can only be used between the light source and the negative. They cannot be used between the lens and the printing material as can be done with CC filters.

In addition to CP, CC, or dichroic filters, a CP2B or equivalent filter is usually built into the enlarger to absorb ultraviolet radiation emitted by the enlarger's light source.

VOLTAGE REGULATION.—Fluctuations in line voltage are more common than is generally realized, and affect both the intensity and color quality of an enlarger's light source. As little as a 5-volt variation in the normal operation range (100-125 volts) can change the lamp's output by about 15 percent, and, therefore, the color quality of the light by about the equivalent of one CC10 filter.

To prevent voltage fluctuation the enlarger should be connected to a voltage regulator which in turn is plugged into the power source. Though it is probably best to standardize on a constant 105 volts, almost any constant voltage regulating unit which provides between 95 to 120 volts is satisfactory. The unit should be equipped with a voltmeter to ensure that the proper voltage is maintained.

Lens Quality

It is important that the color enlarger's lens be free of chromatic aberration. That is, it must be a color-corrected lens.

Exposure Time

Just as the exposure latitude of color film is narrower than that of black and white film, so also is the exposure latitude of color printing material as compared to black and white material. For this reason, accuracy of exposure timing is essential to the production of high quality color prints.

Light Leakage

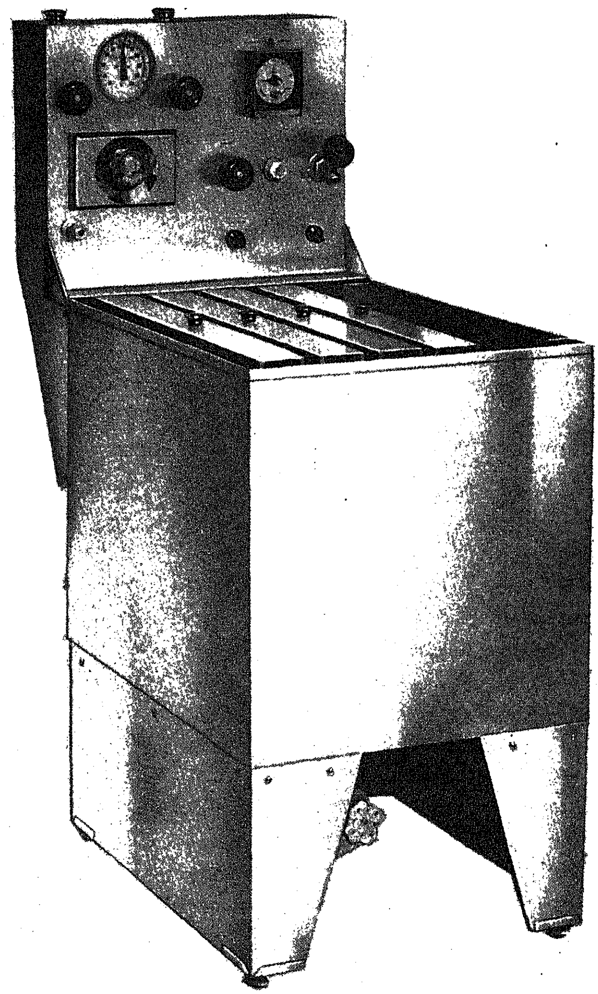
Color enlargers must be designed so that light is emitted only through the lens. Because of the high sensitivity of the color print material, extraneous light fogs the materials and degrades the product. Before printing any color material, you may find it necessary to block off minor light leaks from the enlarger.

COLOR PRINT PROCESSING

Color print processing differs from black and white print processing mainly by the fact that color development is carried out in total darkness and for a specified time at a specified temperature. Black and white print development can usually be varied by increasing or decreasing development time within a reasonable amount, and the temperature of the solutions can vary a few degrees. Such is not the case with color print processing.

Trays are seldom used to process color prints. Tray processing would be inconvenient to say the least. With trays, the solutions quickly become exhausted, solution temperatures are difficult to maintain and production is very slow. Color prints, therefore, are generally processed in automatic color print processing machines or in semiautomatic color print processors.

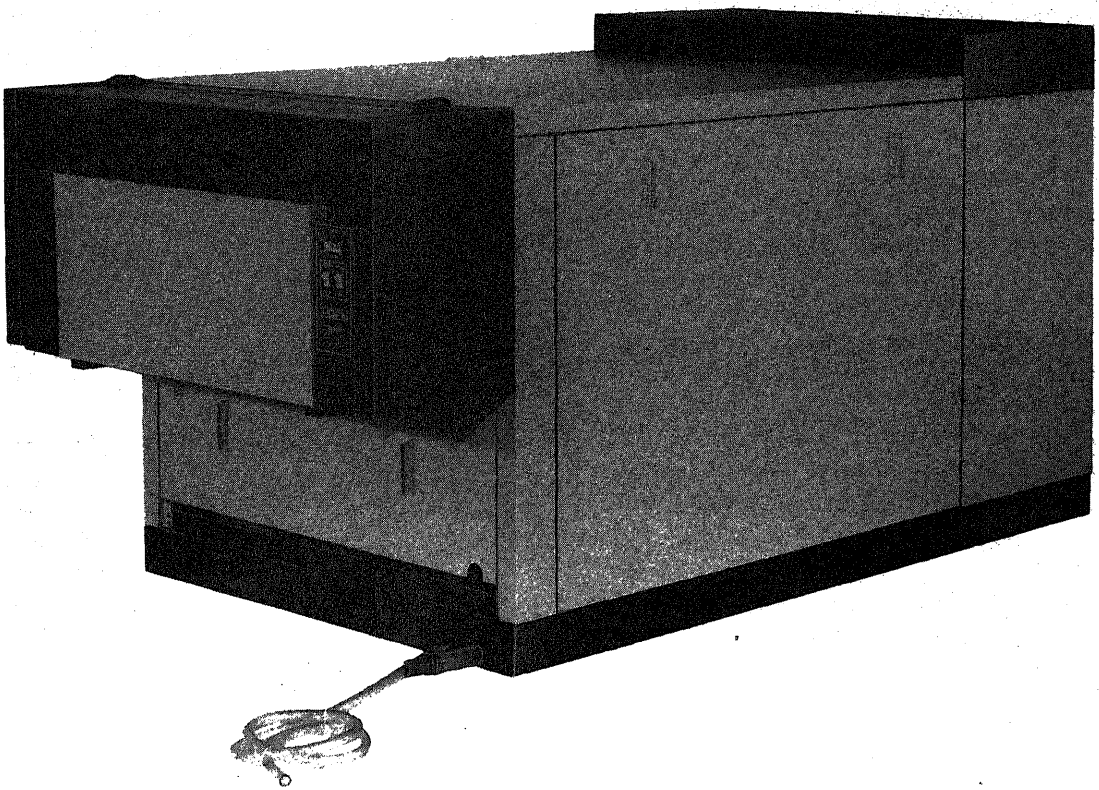
Color print processing, in and of itself, will be discussed later in this chapter. Machine processing will be discussed in chapter 6. In this section on processing let it suffice to say that a semiautomatic print processor is simply a glorified sink which consists of timers, water temperature and flow controls, a water bath, an automatic gas burst type agitation system, tanks, racks, baskets, and covers, etc. When using a semiautomatic color print processor you are actually hand processing prints. The exposed color printing paper is loaded into a basket which holds several prints at a time. The basket is lowered, by hand, into the various solutions, and the agitation system is turned on. At the end of a specified time the basket is removed from one solution, drained, and placed into the next solution. Although not as productive and quick as automatic processing machines, semiautomatic print processors do have their place in Navy photo labs—especially those not engaged in large volume color print production.



Semiautomatic color print processor.

PRINTING COLOR NEGATIVES

A good color print has been termed the ultimate product of still photography, and for



Courtesy Hope Industries Inc.

Automatic color print processor.

years was the most difficult to achieve. However, with the good color materials we have available to use today, color printing is as flexible and practical as black and white printing. Of primary interest to you, as a Navy photographer, is the negative/positive method of producing prints of high color fidelity with a full range of hues. With the negative/positive method of color printing you have control over the finished print—control that allows you to compensate for slight overexposure or underexposure as well as accomplish dodging or printing in. Specifically, areas can be lightened or darkened, and colors can be controlled.

An additional advantage of color negative materials is that you can make color prints, color slides, or black and white prints directly from some color negatives.

Good color prints are not difficult to make. Anyone who has normal color vision and who can and will follow instructions can quickly learn to make good color prints.

There are two methods of making color prints: the *white light exposure* method and the *tricolor exposure* method. In the Navy we use the white light method and that is the method to which the material in this chapter refers.

The following material, commencing with "Printing—Step-by-Step," on page 5-8 and ending with "Making Transparencies from Color Negatives" on page 5-26 is, in part, derived from Eastman Kodak publications E-66; *Printing Color Negatives,* fifth edition, first printing 1974 and the 1978 edition of *Printing Color Negatives*.

PRINTING—STEP-BY-STEP

Color printing consists of three activities:

- *Exposing* refers to all the work that is done in the darkroom, from putting the negative in the enlarger to loading the paper in the processing equipment.

1. Place the filtration in the enlarger.
2. Clean the negative.
3. Compose the image.
4. Focus.
5. Expose.

- *Processing* may or may not be done in the color print darkroom. Processing may be carried out by hand in semiautomatic processing sinks or by completely automatic machines.

6. Process, wash, and dry the print. (This is done either by hand or machine.)

- *Evaluating* is the most difficult part of color printing. You must be able to look at a processed print and decide what corrections (if any) are needed to obtain acceptable density and color balance.

NEGATIVE/POSITIVE PROCESS

The negative/positive color process is comparable to the black and white process in that a negative record of the scene photographed is made by camera exposure followed by processing. This record or color negative is not intended for viewing but is, like a black and white negative, used to make a positive by further exposure and processing.

When a color negative material is exposed in the camera, each color in the scene is recorded in the appropriate emulsion layer of the film. Remember, negative color films have three emulsion layers, one sensitive to red light, one to green light, and one to blue light. When the film is processed these emulsion layers contain dye images which are cyan, magenta, and yellow respectively. Therefore, all red details in the scene are recorded in the cyan dye layer, all green details in the magenta dye layer, and all blue details in the yellow dye layer. All other scene colors are recorded proportionally in two or more layers. When the film is processed, the film images appear negative in tone value and are complementary in color to the original scene colors. That is:

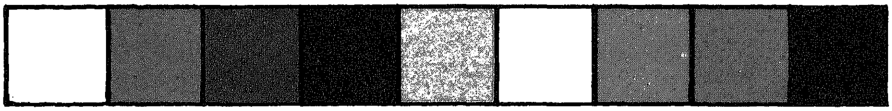
- darker hues are recorded as lighter hues
- red is recorded as cyan
- green is recorded as magenta
- blue is recorded as yellow

The color negative is then used in the printing stage. In principle, the negative is printed onto a second tripack material—the color printing paper.

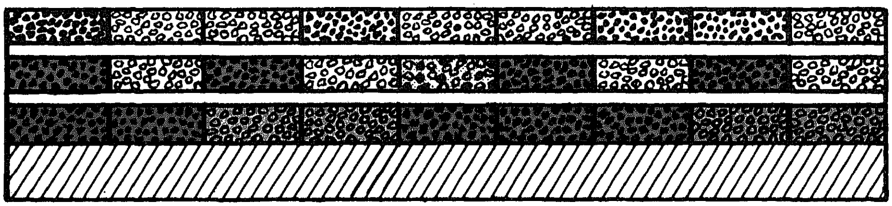
The color printing paper is a tripack reflection type material with the emulsion sensitivity of the three layers reversed from that of the color negative film. The top layer of the paper is sensitive to red; the middle to green; and the bottom to blue light. Of course no orange masking, such as that in color negatives, is used in color printing paper since the purpose of the paper is to reproduce the original scene in full subject color.

As in other color materials, the color of the dye formed in each emulsion layer of the paper, during processing, is complementary to the color sensitivity of the layer. Thus the original subject colors are reproduced in the print. Since the colors reproduced in the color negative are complementary to the original subject colors, a red car is cyan in the negative. Cyan is a combination of blue and green; therefore, the two emulsion layers in the paper that are sensitive to blue and green are affected when the negative is printed. Then during print processing, yellow dye forms in the exposed portion of the blue sensitive layer of the paper, and magenta dye forms in the exposed portion of the paper's green sensitive layer. Yellow and magenta in combination produce red. Therefore, the red car is reproduced in its original color. All of the other colors form in the same way.

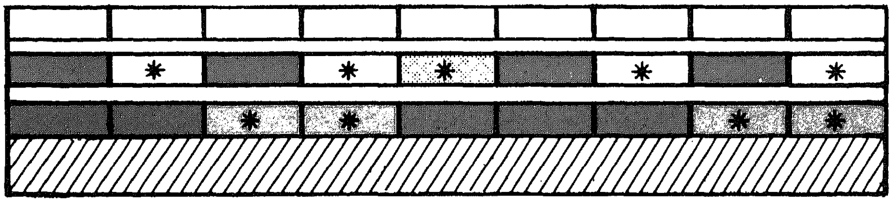
REPRODUCTION OF COLORS BY THE COLOR NEGATIVE SYSTEM



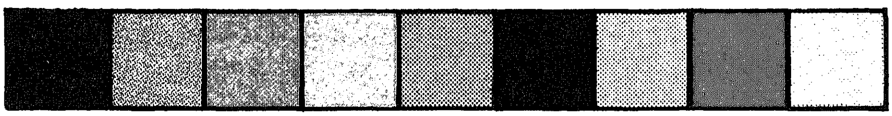
Original subject, represented schematically by color patches.



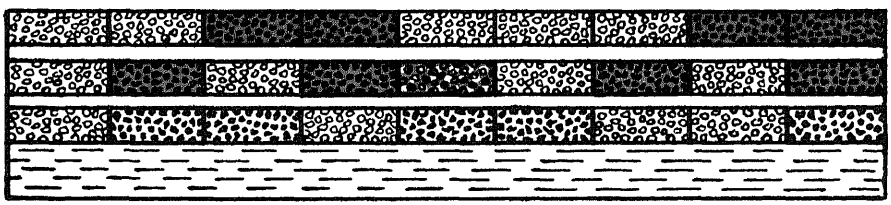
Cross section of color negative film after the silver-halide grains exposed in the camera have been developed to produce negative silver images and dye.



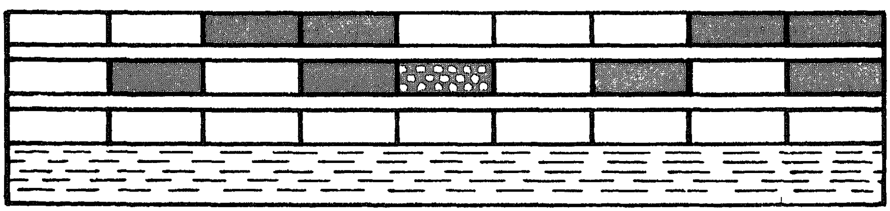
Cross section of color negative film after the silver grains have been bleached.
*Residual color couplers.



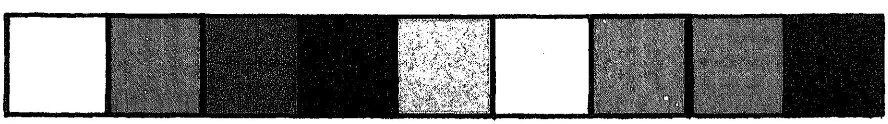
Color negative.



Cross section of color paper after the silver-halide grains exposed by the enlarger have been developed to produce silver and dye images.



Cross section of color paper after the silver images have been bleached, leaving only the positive dye images.



EKTACOLOR Paper dye images as they appear when the print is viewed by reflected light.

finished color print should be an approximation, in two dimensions, of a scene containing objects of familiar shapes and colors. Our task is to control the photographic system so that the viewer of the finished print sees a reasonably accurate reproduction of the scene and comfortably recognizes the objects in it.

In black and white printing, the controlling variables are primarily density and contrast. In color printing, the variables also include, naturally, the color of the individual objects in the scene, as well as the overall color balance of the print. The mood of the picture can be changed by altering this color balance. A winter landscape may be printed on the blue side, perhaps, intensifying the feeling of coldness. Portraits, on the other hand, are usually warm, with glowing flesh tones, reflecting health and happiness.

The color of the area that surrounds an object influences the actual color balance of that object greatly. To make a flesh tone look correct against a green background, for instance, its magenta content must be much less than it would be if viewed against a gray background, since complementary colors intensify each other.

Another variable that influences the color quality of the print is the nature of the light under which it is viewed.

Because of the number of variables that must be controlled to produce an acceptable color print, it is highly unlikely that you will make a perfect color print on the first attempt. The first print must be considered a test to be evaluated for contrast, density, and color balance. The final print must be a satisfactory combination of these variables.

Significance of Tests

Let us consider the relationship of these objectives—satisfactory contrast, density, and color balance. Color printing papers such as **Kodak Ektacolor** 74 RC Paper are designed to reproduce the normal contrast characteristics of properly exposed and properly processed negative materials. Therefore, in the great majority of cases, contrast control is automatic.

When considering density and color balance of a test print, think in terms of the three dye printer light source that reach the red, green, and blue sensitive emulsion layers of the paper. The amount of exposure in each of the paper emulsion layers is controlled by both the length of time the enlarger is on and the amounts of dye in the negative. Increasing the exposure of any of the emulsion layers of the paper increases the dye density of that layer. Conversely, decreasing the exposure decreases the dye density.

Color paper is balanced in manufacture so that the use of a combination of magenta and yellow filters in the printer light source is usually required to make a balanced print from color negatives that have been properly exposed. Because of variations in the colors of light sources, both picture taking and printer, processing variations, and necessary film and paper manufacturing tolerances, the required combination of filters often changes from negative to negative. By evaluating the test print in terms of cyan, magenta, and yellow dye layer exposure, you can ascertain the individual "personality" of the negative in relation to the paper emulsion. You can then alter the filter combination and exposure time to satisfy the requirements of the negative.

Test Conditions

THE COLOR NEGATIVE.—For making the first print and as a basis for producing prints from negatives of unknown printing qualities, it is advisable to select a test negative that has been carefully exposed with a light source of the correct color quality and the proper intensity. The subject matter should be, as nearly as possible, typical of that to be printed in the future, and should contain some neutral areas (such as a reproduction of the gray side of the Kodak Neutral Test Card).

Make sure the negative is free from dust and place it in the enlarger so that its emulsion side is toward the lens. (The emulsion side of Kodak color rollfilms is toward you when the arrows along the top edge are pointing to the right. In sheet films, the emulsion side is toward you when the notch code is at the top right-hand corner.) Elimination of stray light around the edges of the negative image is absolutely essential. Masks of black paper and/or black masking tape in the negative carrier will prevent stray light from fogging the paper.

TRIAL EXPOSURE.—A tungsten enlarger used for exposing color paper must be equipped with heat-absorbing glass: a tungsten-halogen enlarger must have forced-air cooling fans in addition to the heat-absorbing glass. An ultraviolet absorber, such as a Kodak Wratten Filter No. 2B, must always be included in the light beam, preferably above the negative.

Since enlarging equipment varies considerably, it is difficult to specify exact exposure times and filtration for a properly exposed print. You should consult the data sheet packaged with the color printing paper to arrive at a starting exposure time and filter pack.

Judging Test Prints

VIEWING CONDITIONS.—The color quality of the viewing light source strongly influences the apparent color balance of the print. Ideally, the evaluation area should be illuminated by light of the same color quality and intensity as that under which the final print is to be viewed. From a practical standpoint, some average condition must be selected.

Several factors are important in specifying light sources for viewing color prints. These are intensity, color temperature, and Color Rendering Index. The intensity of the light source influences the amount of detail that can be seen in a print. For good viewing, a light source should provide an illuminance of 1400 lux ± 590 lux (130 footcandles ± 55 footcandles). The color temperature of the light source should be between 3800 and 5000 °K. The most important characteristic of the light source is its Color Rendering Index (CRI). The CRI is a scale from 0 to 100 used to describe the visual effect of a light source on eight standard pastel colors. For good color rendering in the prints being viewed, the CRI of the light source should be between 85 and 100.

The quality of a light source having a CRI of at least 90 and an equivalent color temperature near 5000 °K is approximated by fluorescent tubes (in fixtures), such as the Westinghouse Living White or the Deluxe Cool White tubes made by several manufacturers. Satisfactory results can also be obtained by using a mixture of incandescent and fluorescent light. For each pair of 40-watt Deluxe Cool White fluorescent tubes, a 75-watt frosted tungsten bulb can be used.

More detailed information on print viewing can be found in American National Standard PH2.41-1976, *Viewing Conditions for Photographic Color Prints*, available from the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

PRINT EXAMINATION.—Study the color balance and density level of the test print. Look at the areas that should be reproduced as tones of gray and decide whether they have been affected by a variation from neutral color balance. In recognizing the variation from neutral color balance, think of it as an overexposure or underexposure of one or more of the paper emulsion layers. For example, if the grays appear greenish and light, the magenta dye layer has been underexposed. On the next printing of this negative, more light of the color to which this layer is sensitive (i.e., green light) must be allowed to strike the paper. If, on the other hand, the grays appear greenish and dark, the dye layers that combine to make the color green (cyan and yellow) have been overexposed and should be corrected on the next printing by shortening the red and blue exposure time. In both examples magenta filtration must be removed from the pack.

If the print appears magenta and dark, hold back green light on the next printing by adding magenta filtration to the pack.

Look at the reproduction of highlights and decide whether overexposure has caused them to be muddy or underexposure has caused them to lack detail.

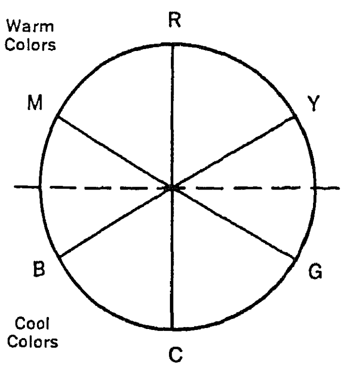
Some changes in exposure conditions will probably be necessary. If the test print is far from the proper density or color balance, the changes required can probably be estimated only roughly. A second test print will be necessary before the final print(s).

USE OF A RING AROUND.—Comparing the test print to a series of prints that vary in known amounts from a standard print of acceptable balance (such as those included with Kodak publication E-66; *Printing Color Negatives*) is a simple method of determining color and density correction, particularly on a test print that is far from correct. The test print is matched as closely as possible to one of the ring around. The amount and color of filtration that should be added to the filter pack are the same as the designation of the ring around. (If the color is cyan, green, or blue, subtract the complementary color.)

If the test print is reasonably close to being satisfactory, it should be possible to predict the final exposure conditions accurately. Once again, thinking of the test print in terms of the exposure of the three dye layers will simplify the choice of correcting filters.

USE OF VIEWING FILTERS.—If a test print is reasonably close to desirable color balance, viewing it through CC or CP filters provides a means of determining accurately what color change is wanted. Since a filter used in this way tends to overcorrect the highlights and undercorrect the shadows, it should be selected on the basis of correcting the lighter middle tones to the desired color balance. Be sure to view the print under the proper lighting conditions and to hold the filter neither so close to the print that the light falling on the print passes through the filter first, nor so close to your eyes that the filter influences general color adaptation. Do not stare through the filter at the print for an extended length of time, but rather flick the filter in front of the print and then away several times, observing the degree of correction it makes. Try several filters of different values and colors when evaluating a test print. If, for example, the print looks "cold" to you, evaluating it through a series of red, magenta, and yellow filters will determine whether the offending balance is cyan, green, or blue. Similarly, viewing a "warm" print through cyan, green, and blue filters will determine if the offending balance is red, magenta, or yellow.

Since the contrast of the print material is fairly high, a filter used in exposing a print tends to produce a greater change in color balance than might be expected from the visual effect of a filter of the same strength used in viewing. In general, *the filter added to the filter pack should be the complement and half the strength of the viewing filter that makes the lighter middle tones of the test print appear best.*



Color relationships.

Suppose, again, that the test print is too green—that is, the magenta dye image is too light relative to the cyan and yellow dye images. The print will look best through a magenta filter, but getting relatively more exposure into the green sensitive layer where the magenta dye is formed necessitates adding green filtration to the pack or removing magenta filtration. If a 20M filter was best for viewing, adding a 10G filter or, better, removing a 10M filter from the pack should accomplish the desired correction.

Kodak Color Print Viewing Filter Kit

Kodak Publication No. R-25, the **Kodak** *Color Print Viewing Filter Kit,* consists of six color print viewing filter cards and instructions packaged in a vinyl wallet. Each viewing card contains one of six filter colors: red, green, blue, cyan, magenta, and yellow. Each color is represented in 10, 20, and 40 density values. Each filter card is index tabbed with the color of the filter and the color it modifies. Each card contains, in addition to the density values of each viewing filter section, instructions for adjusting the printing filter pack to obtain the desired print correction.

The instruction sheet includes examples of filter pack adjustments, a computer number and filter factor chart for **Kodak** CC and CP filters, filter fundamentals, color relationships, and instructions for combining filters.

The **Kodak** Color Print Viewing Filter Kit is a compact, effective, and relatively inexpensive training tool for the beginning color printer, as well as being a handy double check for the experienced worker to evaluate color balance.

Modifying the Filter Pack

When it has been decided which color predominates in the test print, a filter of that same color can be *added* to the pack. However, it is *more desirable* to *subtract* a complementary filter, and this procedure should be adopted whenever possible.

The following table may be useful in determining what filter adjustment should be made.

Filter Pack Adjustments

If the color balance is:	If possible, subtract these filters:	or Add these filters:
Yellow	Magenta and Cyan (or Blue)	Yellow
Magneta	Cyan and Yellow (or Green)	Magneta
Cyan	Yellow and Magneta (or Red)	Cyan
Blue	Yellow	Magenta and Cyan (or Blue)
Green	Magenta	Cyan and Yellow (or Green)
Red	Cyan	Yellow and Magenta (or Red)

For example, if the print is too red, remove a cyan filter from the filter pack. If there is no cyan filter present in the filter pack, add yellow and magenta filters (or the equivalent red filter).

The following rough guide may also be helpful: When a slight shift in color balance is needed, use an 05 or 10 filter change; when a moderate shift is needed, use a 15 (05 plus 10) or 20 change; and when the shift required is too large to estimate, try a 30 change.

The filter pack should not contain more than two colors of the subtractive filters (yellow, magenta, and cyan). When all three colors are in the filter pack the effect is neutral density (ND) which only serves to increase the exposure time required. Neutral density is eliminated by removing the filter color of least density completely, and then removing the same density of each of the other two colors. Thus, if you calculated the filter pack to be 30M + 20Y + 10C you would completely remove the 10C + 10M + 10Y to give a filter pack of 20M + 10Y + 0C.

The *Kodak* Color Print Viewing Filter Kit, Kodak Publication No. R-25, is used to view a test print in order to determine the proper filter-pack correction for reprinting.

The effect of filter changes on exposure must be kept in mind. For example, if diffused whites in a test print are reddish, it may work out well to add a 10R filter, or 10M plus 10Y, to the pack and to use the same exposure again. On the other hand, correcting the color balance by removing a 10C filter from the pack will definitely call for a decrease in exposure.

With experience, exposure adjustments can be estimated fairly accurately when the test print is close to the desired density and color balance. More detailed information on exposure adjustments required by filter changes is given in the following table.

Exposure Factors for Kodak CC and CP Filters

Filter	Factor	Filter	Factor
05Y	1.1	05R	1.2
10Y	1.1	10R	1.3
20Y	1.1	20R	1.5
30Y	1.1	30R	1.7
40Y	1.1	40R	1.9
50Y	1.1	50R	2.2
05M	1.2	05G	1.1
10M	1.3	10G	1.2
20M	1.5	20G	1.3
30M	1.7	30G	1.4
40M	1.9	40G	1.5
50M	2.1	50G	1.7
05C	1.1	05B	1.1
10C	1.2	10B	1.3
20C	1.3	20B	1.6
30C	1.4	30B	2.0
40C	1.5	40B	2.4
50C	1.6	50B	2.9

To use factors: First divide the old exposure time by the factor for any filter removed from the pack. Then multiply the resulting time by the factor for any filter added.

For two or more filters, multiply the individual factors together and use the product.

Multiple Test Exposures

Once the basic filter pack has been determined for a typical negative, the same exposure conditions can be used when tests are made with other negatives on paper of the same emulsion number. If the negatives are small, a convenient procedure is to tape several to a sheet of plate glass, with the base of the film in contact with the glass. Adjust the enlarger to give the same degree of enlargement that is later to be used in printing the negatives, using a negative mask or negative carrier of the proper size in the enlarger head. If an 8 × 10 inch enlargement is to be made from each negative, the cone of light from the enlarger should be large enough to cover the 8 × 10 inch sheet of glass with all the negatives taped to it. If the magnification is different from that used for the negative previously enlarged, adjust the lens opening to compensate for the difference.

Now lay a sheet of the color paper on the enlarger easel and cover it with the negatives. Expose the sheet as indicated by previous tests; then process and dry it.

Assuming the exposure level for the contact test prints proves to be correct, exposures will be about the same when the negatives are placed in the negative carrier and enlarged. Allowance must be made, however, for changes to improve color balance or density that are determined from an analysis of the contact test prints.

If the negative previously enlarged is included among those from which the contact prints are made, it forms a standard of comparison or "standard negative." Each of the other contact prints can then be compared with the reproduction of this standard negative. In this way, only the differences characterizing the individual negatives will enter into the comparison. Other variables, such as a departure of the test print process from normal color balance, will be eliminated.

Incidentally, do not discard test prints. Instead, write on them the actual exposure conditions and the predictions made from the test results. Such records will enable you to gain the greatest practical value from past work. Properly applied, they will help you develop the judgment needed for easier color printing in the future.

Kodak Ektacolor FilterFinder Kit

Eastman Kodak Company also makes a **Kodak Ektacolor** FilterFinder Kit. The kit presents a simple, step-by-step approach to making color prints from color negatives. Used properly, the kit will help you make enlargements with proper color balance and density, and will

help minimize wasted time, paper, and chemicals. The FilterFinder Kit consists of:

- The **Kodak Ektacolor** FilterFinder. This is the heart of the kit. It is a specially made piece of film that helps determine proper filtration and exposure when making color prints from color negatives.

- The Locator. This is a nine-step gray scale that helps you evaluate your test prints for accuracy of filtration and exposure.

- The Gray Card. The **Kodak** Neutral Test Card (Gray Card) helps you record the characteristics of the light illuminating the original subjects you photograph. The resulting "gray card negative" is then used, along with the other items in the kit, to help you determine correct filtration and exposure during printing.

- The Calculator Dial. This multipurpose calculator dial helps you perform many darkroom calculations quickly and easily. It can help you to:
    - compensate for image size changes;
    - determine exposure times at different f/stops;
    - use exposure factors;
    - use filter factors.

- The Instruction Booklet. This complete text, illustrated in color, contains simple, field tested, step-by-step directions on how to use the **Kodak Ektacolor** FilterFinder Kit.

The FilterFinder Kit was designed to help simplify making prints from color negatives. To use the kit you follow a four-step procedure.

1. Photograph the gray card. You photograph the gray card with your subject or under the same lighting conditions.
2. Make test prints. After the film is processed, you make test prints to determine the best average filtration and exposure to use for printing the negatives shot under the same conditions as the gray card.
3. Make proof prints. You make prints to preview what your enlargements will look like and to edit your negatives.
4. Make enlargements. Changing image magnification for different size enlargement is easy when you use the calculator dial.

The **Kodak Ektacolor** FilterFinder Kit can help all color printers from beginners to experts. For beginners, it presents a method of getting good prints with a minimum of trouble. For experts, it offers a way to determine the proper color balance for hard-to-print negatives, a way to zero in new paper emulsions, and a way to do routine control checks.

THE STANDARD NEGATIVE

Briefly defined, a standard control negative is an average, normal color negative that has been properly exposed under known conditions and that is known from actual trial to make an excellent print. In other words, it has been printed previously, and an accurate record of the filter pack required for a particular paper emulsion is available. Here, therefore, is a standard that can be used for comparison purposes. The standard negative can be useful in at least three different ways:

- for comparing its printing characteristics with those of other color negatives

- for comparing different paper emulsions

- for checking processing

STANDARD NEGATIVE CHARACTERISTICS

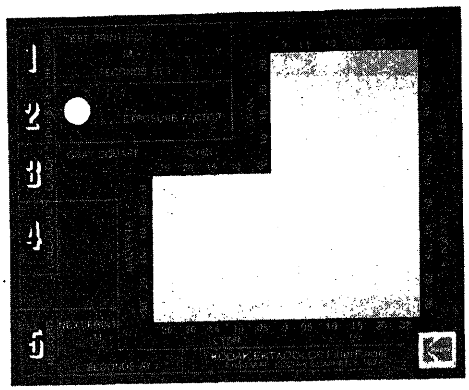
The standard negative should be typical of the majority of negatives to be printed. If most of your negatives are outdoor shots on Kodak Vericolor III Professional film, the standard negative should obviously be an outdoor shot on **Kodak Vericolor** III Professional film. Further, it should be normally exposed, it should be normally processed, and it should be of a typical subject with typical lighting. That is, the lighting ratio and light direction should be similar to most of the negatives that are to be printed.

Depending somewhat on the nature of the subject and lighting, a normally exposed color negative read through the red filter of an

The KODAK EKTACOLOR FilterFinder Kit

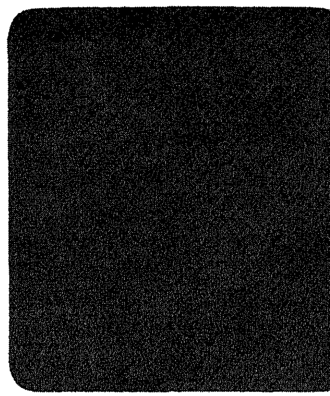
The KODAK EKTACOLOR FilterFinder Kit presents simple, step-by-step approach to making prin from color negatives. It is an excellent printing a because it allows you to analyze negatives by th roll instead of individually. Used properly, the k will help you make enlargements with proper col balance and density, and will help minimize waste time, paper, and chemicals.

The filterfinder kit consists of:



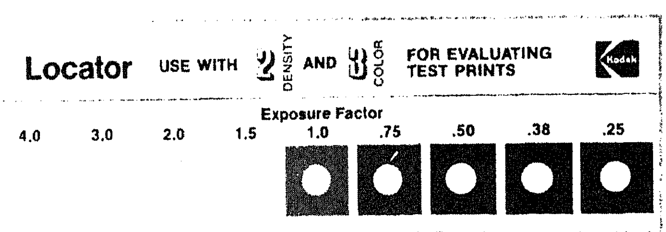
The KODAK EKTACOLOR FilterFinder.

This is the heart of the kit. It is a specially made piece of film that helps determine proper filtration and exposure when making color prints from color negatives.



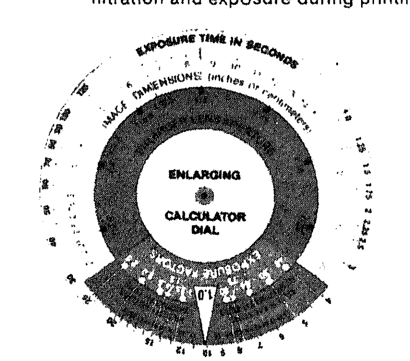
The Gray Card.

This KODAK Neutral Test Card (Gray Card) helps you record the charac-teristics of the light illuminating the original subjects you photograph. Th resulting "gray card negative" is the used, along with the other items in th kit, to help you determine correct filtration and exposure during printi



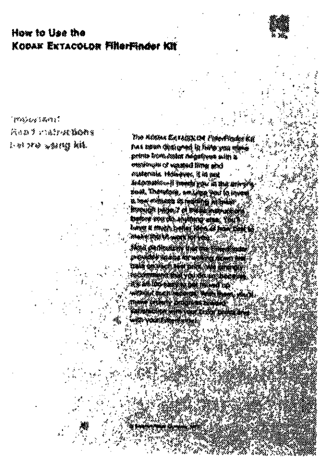
The Locator.

This nine-step gray scale helps you evaluate your test prints for accuracy of filtration and exposure.



The Calculator Dial.

This sturdy, multipurpose Calculator Dial helps you perform many darkroom calculations quick and easily. It can help you to: • compensate for image size changes • determine exposure time different f/stops • use exposure factors • use fi



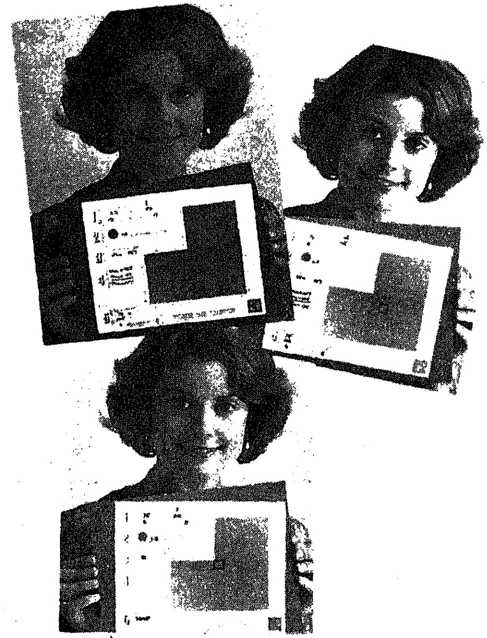
The Instruction Booklet.
This complete text, illustrated in color, contains simple, field-tested, step-by-step directions on how to use the KODAK EKTACOLOR FilterFinder Kit.

The filterfinder kit was designed to help simplify making prints from color negatives. To use the kit you follow a 4-step procedure.

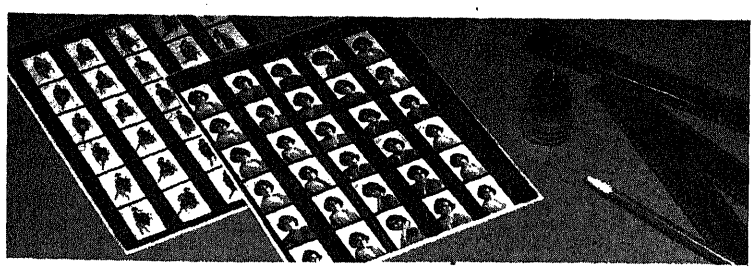
1. Photograph the gray card.
You photograph the gray card with your subject or under the same lighting conditions.

The KODAK EKTACOLOR FilterFinder Kit can help all color printers from beginners to experts. For beginners, it presents a method of getting good prints with a minimum of trouble. For experts, it offers a way to determine the proper color balance for hard-to-print negatives, a way to zero-in new paper emulsions, and a way to do routine control checks. All color printers can benefit from the reduced waste of time, paper, and chemicals.

The KODAK EKTACOLOR FilterFinder Kit is available through your photo dealer, or you can order it directly from Kodak. See the inside back cover for ordering details.



2. Make test prints.
After the film is processed, you make test prints to determine the best average filtration and exposure to use for printing the negatives shot under the same conditions as the gray card.



3. Make proof prints.
You make prints to preview what your enlargements will look like and to edit your negatives.

4. Make enlargements.
Changing image magnification for different size enlargements is easy when you use the calculator dial.

electronic or visual densitometer should have the following approximate densities:

Reference Area	Normal Red Filter Density
Kodak Neutral Test Card (gray side) receiving the same illumination as the main subject	0.65 to 0.85
Lightest step (darkest in negative) of a **Kodak** Gray Scale receiving the same illumination as the main subject	1.15 to 1.35
Highest diffuse density in a normally lighted forehead —light complexion —dark complexion	 0.95 to 1.25 0.65 to 1.05

It will help considerably if the standard negative contains some areas that are relatively sensitive to minor color balance changes. For example, sunsets or flowers are not good standard negative test subjects because they often can be printed over a wide range of color balance and still be pleasing. However, the face in a portrait is a sensitive area, as is any near neutral, such as a sunlit concrete surface. Surprising as it may seem, a prominent sunlit tree trunk may be helpful in judging small color differences in middle tones and shadow areas. Best of all is a gray scale or a card of 18-percent reflectance, such as the gray side of the Kodak Neutral Test Card placed in the scene.

In some cases, it may be advantageous to have a "primary" standard negative for the most usual film-subject-lighting situation, plus one or more "secondary" negatives representing other situations. A basic enlarger filter pack should be determined for each negative.

COMPARING PRINTING CHARACTERISTICS

Most color negatives of the same type of

similarly, but not identically. Differences may result from variations in lighting (time of day, sky conditions, etc.), variations in film emulsion, variations in film processing, or other factors. These differences are normal and should be expected. However, the important thing is to think of these balance variations *in terms of filter differences between each negative and the standard negative.*

Thus, for making a normal print from the standard negative, suppose the filter pack consists of 40M + 60Y, and the best print density is attained at an exposure time of 10 seconds at f/5.6. These filters should remain in the optical system of the enlarger as an excellent *starting point* for similar negatives as long as the same emulsion number of color paper is being used. For a particular negative, perhaps it will be necessary to add a 10M filter to the pack and adjust the printing time to 12 seconds in order to compensate for the differences between the new negative and the standard negative. In other words, the new negative prints *differently* from the standard negative by a 10M filter and a 20-percent increase in printing time.

Record this data with the new negative, because the relative difference *will remain constant*, regardless of the characteristics of the paper emulsions that might be used in the future. For example, 6 months from now a reprint of this negative might be needed. But now a different paper emulsion is in use, and the basic filter pack in the enlarger (to print the standard negative satisfactorily) has become a 20M. It is necessary only to increase the exposure by 20 percent and to add a 10M filter to the pack (or change the 20M to 30M) in order to make a normally balanced print without further test.

Adjustment for Emulsion Number Changes

In multilayer color materials, there are unavoidable differences in color balance and speed from one emulsion number to another. The extent of these variations is noted on the package label. After the material leaves the factory, color balance and speed changes are minimized by proper storage and processing.

Exposure data, including an exposure factor and paper filter adjustment in terms of CC filters, are given on the label of each package of color

procedure below to determine the new filter pack and exposure time when changing to a new emulsion.

1. Determine the basic filter pack by *subtracting* the paper filter adjustment for the old emulsion from the filter pack used for that emulsion.

Example: Suppose the filter pack required for the first emulsion in use was 40M + 50Y, and the Paper Filter Adjustment printed on the package label of that emulsion was −10M −10Y. *Bear in mind that subtracting a minus value is equivalent to adding.*

Then:

Filter pack used to print the first emulsion	40M	50Y
Paper Filter Adjustment for the first emulsion	+10M	+10Y
Basic filter value	50M	60Y

2. Determine the new filter pack by *adding* the Paper Filter Adjustment listed for the new emulsion to the basic filter pack. Example: Suppose the Paper Filter Adjustment for the new emulsion is +20M −10Y.

Then:

Basic filter value	50M	60Y
Paper Filter Adjustment for new emulsion	20M	−10Y
Filter pack for new emulsion	70M	50Y

This pack, 70M + 50Y should be tried for the new emulsion.

3. Calculate the new exposure time by the following formula:

$$\text{Exposure time for the new emulsion} = \text{Exposure time for the old emulsion} \times \frac{\text{Exposure Factor for the new emulsion}}{\text{Exposure Factor for the old emulsion}}$$

Example: Suppose the exposure time used for the first emulsion was 10 seconds, the Exposure Factor for that emulsion was 100, and the factor for the new emulsion is 120.

Then:

$$10 \times \frac{120}{100} = 12 \text{ seconds}$$

This is the exposure time that should be tried for the new emulsion.

Due to unpredictable conditions of storage and use, time of exposure and other variables, these factors can be only an approximate guide to the direction of filter changes. They cannot give help in setting up the initial or first filter pack.

CHECKING PROCESSING

For troubleshooting or for use simply as a routine check on processing, use of a standard negative is invaluable as an alternative to the use of control strips (control strips for process monitoring are covered in module 4 of this training series). A small print, made carefully with controlled voltage from the standard negative and processed in the same batch with other prints, will tell at a glance whether there is any abnormality in the processing or procedure.

A supply of these standard negative or control prints sufficient to last 3 or 4 months can be preexposed if the exposed unprocessed prints are held at room temperature for a 48-hour stabilization period. After this stabilization period, wrap the prints individually in aluminum foil to protect them against water vapor, and store them in a freezer operated between 0 and −10 °F. Before processing a batch of prints from other negatives, take one of the preexposed control prints out of the freezer and let it come to room temperature while it is still wrapped. The warmup time for single prints is only a few minutes; keep this time as consistent as possible to minimize color balance changes.

Unless you make advance compensation for latent image loss in exposing the control prints, their color balance will usually differ from that of prints processed soon after exposure. Such a characteristic departure from normal balance does not matter. *However, a control print used to check processing should be compared only with other control prints exposed at the same time on the same batch of paper.*

NEGATIVE EVALUATION

An accurate, quick method of determining the printing characteristics of color negatives is necessary in order to print them economically on a production basis. However the evaluation is accomplished, the results of such a study of a

evaluation of the negative density, can be made. Black and white prints can be made quickly and cheaply, and viewed to determine the exposure adjustment necessary for the final print. But the exposure required to print a color negative is far more difficult to determine by merely viewing the negative or making an exposure series. The black and white way of working may become a time-consuming and costly procedure when applied to color printing. Color negative evaluation methods have been developed to determine quickly and economically the exposure conditions for a color negative.

The negative evaluation technique must provide the exposure time and the specific printing filter pack required. Essentially, color negative evaluation methods compare the relative proportions of red, green, and blue light transmitted by reference areas in an unprinted negative with those of a standard negative. When the exposure data of the standard negative are known, the exposure information for the unprinted negative can be determined easily.

REFERENCE AREAS IN NEGATIVES

For successful negative evaluation, the reference areas that are evaluated must be basically the same subject matter in all the negatives. A gray card included in the picture, a flesh tone, or neutral area such as concrete provides a suitable reference area. In portraiture, a medium flesh tone is often selected. In other fields of photography it is helpful either to include a gray card in the scene or to expose an additional negative with the gray card receiving the main illumination. In the latter case, the negative with the gray card is used only for evaluation purposes; it is replaced by the subject negative when the print is made.

When a skin tone is used instead of a gray card in portrait negatives, the evaluation results will tend to reproduce all skin tones alike, regardless of individual variations in skin color or in the character of the lighting falling on the original scene. Similarly, all images of a gray card tend to be printed alike, regardless of the position of the card relative to the main light.

(or a large percentage of the area) of a negative can be measured and the integrated densities used to determine the exposure. Such methods are called "large area readings," and require an integrating device, as described later in this section.

NEGATIVE VARIATIONS

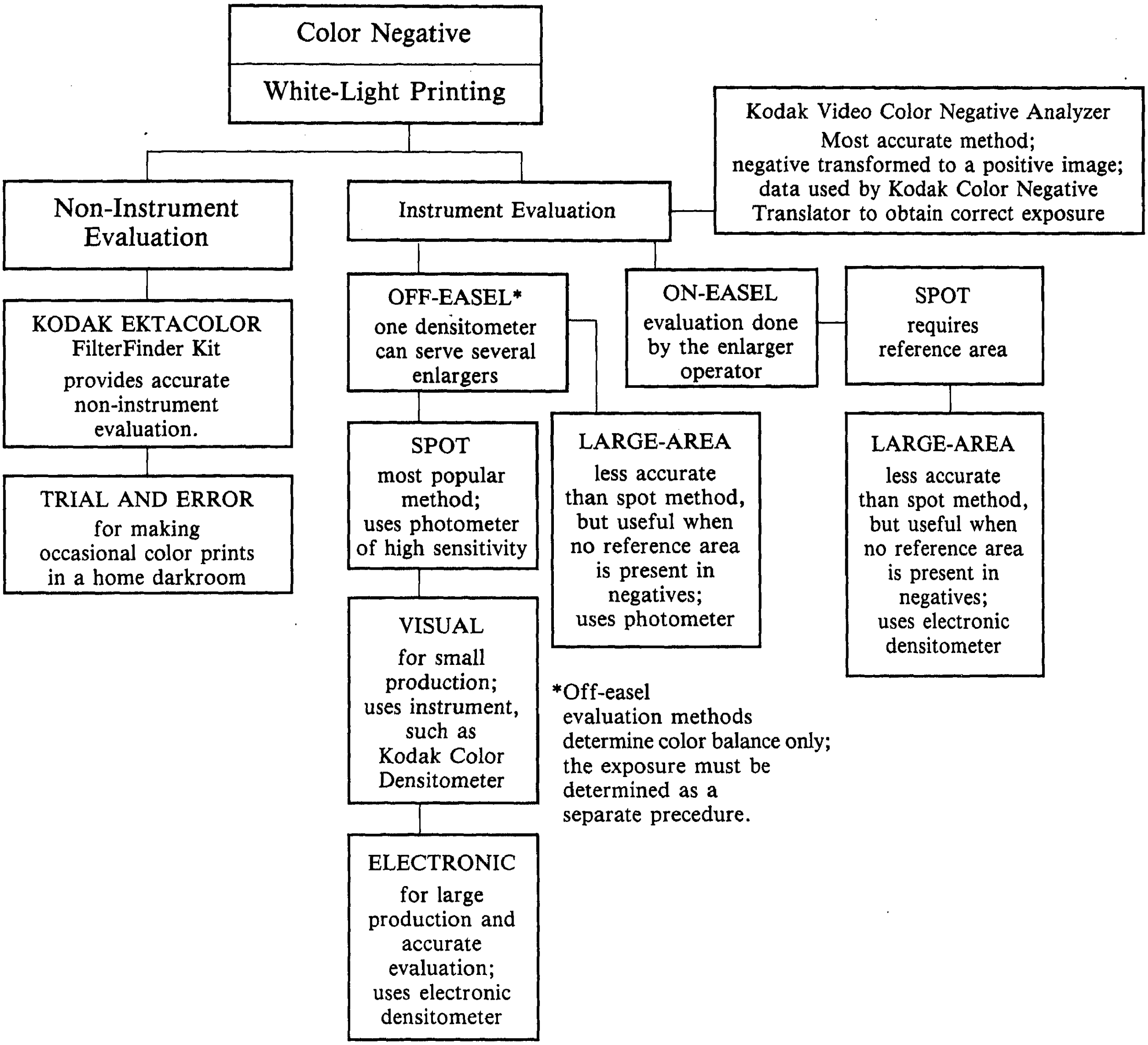
Few characteristics are exactly the same in two color negatives. Even when the subject matter is the same, differences can be caused by normal manufacturing variations from one emulsion to another, adverse conditions before exposure, illumination of different color quality, variance in sensitivity with changes in illumination level and exposure time (reciprocity effect), adverse storage conditions between exposure and processing (latent image loss), and nonstandard processing conditions.

In situations where the exposure and processing of film and paper are standardized and paper having the same emulsion number is used for printing a *given* roll of negatives, all the negatives can usually be printed as indicated by a satisfactory test print from one representative negative.

EXPOSING COLOR PAPER

It is helpful to think of color paper in terms of its three separate emulsion layers. Each layer is sensitive to light of a particular color (red, green, or blue), and each layer must receive the correct exposure in order to yield a print of satisfactory density and color balance. A change in the overall exposure time affects all three dye images, while color compensating filters of one color affect the exposure of one or two emulsion layers, depending on the color of the filter. For instance, a yellow filter affects only the blue sensitive layer, while a red filter affects both the blue and green sensitive layers. By manipulating the variables—overall exposure time and the density and color of the filters placed in the light beam—you can obtain the proper exposure in each of the three emulsion layers.

Familiarity with this color printing concept will help you understand better how negative evaluation works. Basically, these evaluation techniques provide a method of reading the red,

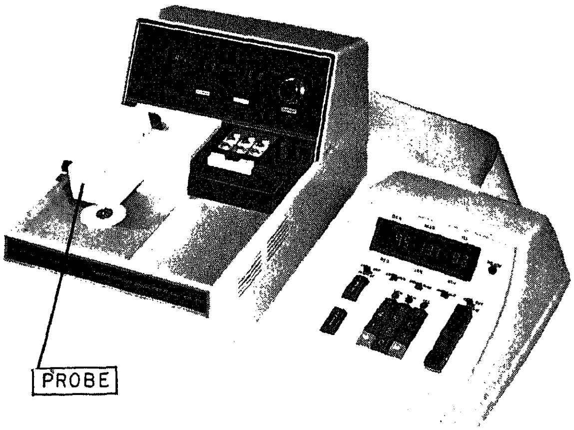


green, and blue densities of the negative. These values provide the information needed to adjust the densities of the various filters in the filter pack so that, when the color paper is exposed, the red, green, and blue sensitive layers of the printing material each receive the proper exposure.

SELECTING A NEGATIVE EVALUATION METHOD

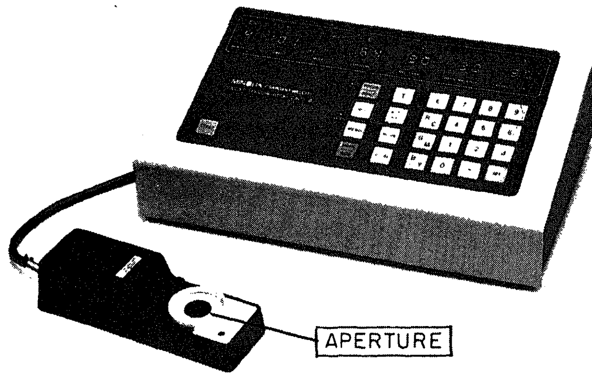
The particular negative evaluation technique that you select or use will depend on the volume of work and on the equipment available. A lab that makes only occasional color prints will probably use the **Kodak Ektacolor** FilterFinder Kit. The first print made by this method is judged; then changes in exposure and filters are made until a satisfactory test print is produced. This method is suitable where time is not of prime importance and equipment is minimal.

Larger Navy photo labs and labs where large quantities of color printing are done use negative evaluation techniques involving instruments such as densitometers, color analyzing photometers, and other electronic devices.



Densichron Products/Sargent-Welch Scientific Company.

Off-easel spot readings are made with the negative positioned so that the image reference area is under the probe.



Densichron Products/Sargent-Welch Scientific Compan

On-easel spot readings are made with the photometer prob placed on the easel so that the image of the reference are in the negative falls on the aperture of the probe.

Negative evaluation techniques using electronic instruments can be performed on or off the enlarger easel. They can be based on reading the densities either in a small part of a negative (spot readings) or over a large percentage of the negative area (large area readings). Experienced workers can usually make the density readings for a negative in less than a minute. These methods are generally capable of producing a high percentage of satisfactory prints on the first try. Procedures based on large area readings are less accurate than those involving spot readings.

Off-easel evaluation methods are particularly useful where enlarging is a production operation and time cannot be spared from actual enlarging activities to perform the evaluation on the enlarger easel, or where it is uneconomical to purchase a sufficient number of photometers to service all the enlargers.

In such cases, color negative evaluation can be set up on a production basis outside the darkroom. By using an off-easel method, a densitometer operator can furnish darkroom workers with filter pack information for each color negative. The darkroom workers need determine only the lens opening and exposure time for the size of the enlargement.

On-easel evaluation is suited to operations in

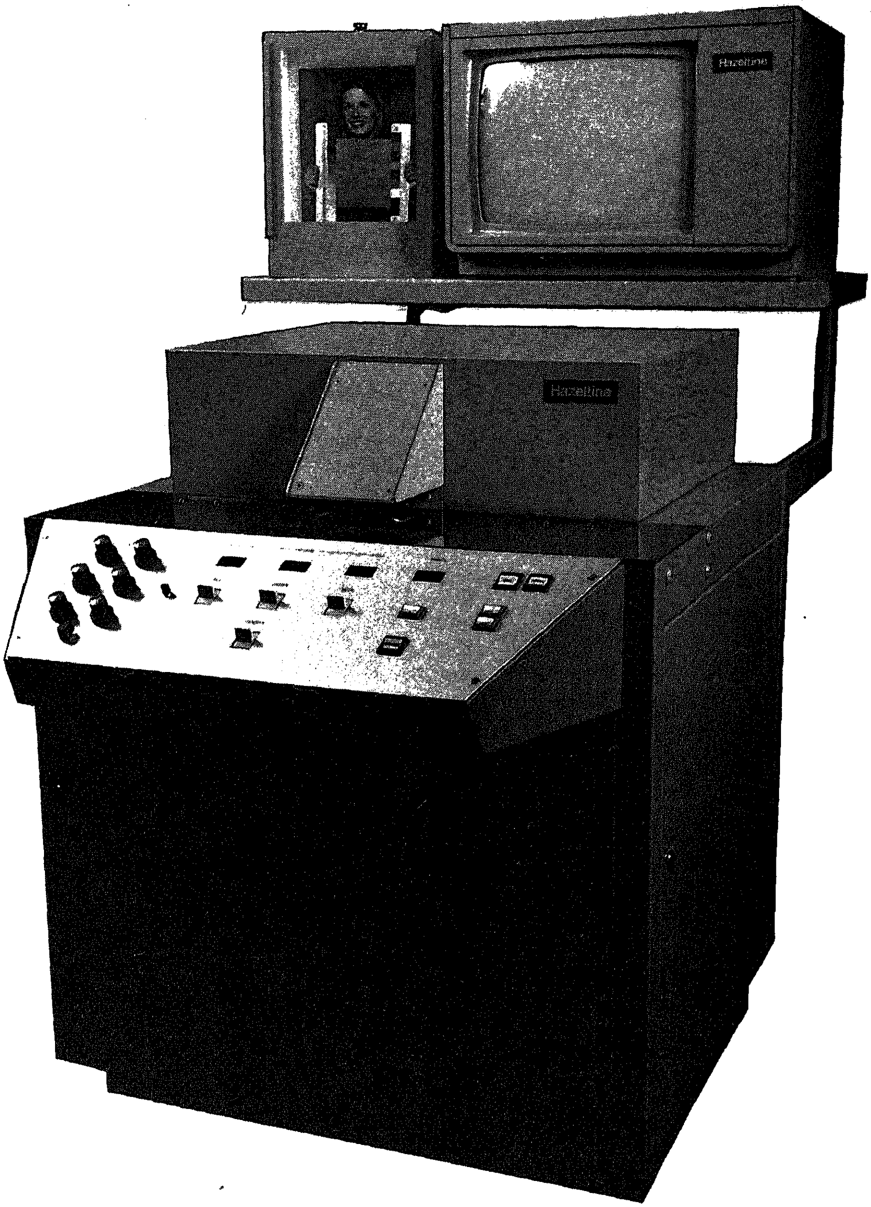
evaluation as well as the printing. If there ar several enlargers in constant operation, eac enlarger can be furnished with a photometer.

If you use electronic instruments to mak negative evaluations, carefully read th instructions accompanying the particula densitometer you are using, so that you becom familiar with the mechanical controls an techniques of using the instrument to determin the filter pack required for printing productio negatives.

Video color negative analyzers determine th printing requirements of color negatives b translating the negative into a high quality positiv color television image. This television imag presents the color balance and density of the prin that would be made from the negative bein evaluated.

Extensive tests of video analyzers with replenished color print processing line resulted first print acceptance of well over 75 percent. O those prints not accepted, only one addition printing was necessary.

Prints from 100 negatives evaluated with th video analyzer will ordinarily require only abou 125 sheets of paper. Thus, a marked increase production capacity is achieved without th involvement of additional personnel or pri



Courtesy Hazeltine Corp.

e television image of a negative is matched to a sample print of the master negative on a color negative video analyzer.

In addition, a video analyzer provides lvantages by allowing the operator to:

- Select the most suitable among a number f negatives without making proofs. For instance, ou can judge expression in portrait negatives.
- Determine dodging and printing-in quirements before printing.
- Judge internegative contrast and color before printing.

Judging Negative Exposures

Color negative exposures can be judged by placing the negative over an illuminator or light table. Viewing the negative through a green filter,

such as the **Kodak Wratten** Filter No. 61, makes it appear much like a black and white negative and helps in determining whether adequate shadow detail has been obtained.

With a **Kodak** Color Densitometer, or a suitable electronic densitometer equipped with filters such as the **Kodak** Densitometer Filter Set MM (Certified) or a **Kodak Wratten** Filter No. 92 (red), a more accurate check on the exposure level can be made.

COLOR PRINT PROCESSING

In this section we will not give you specific step-by-step instructions on color print processing. That information is available to you in the form of instructions packaged with both the paper and chemicals you will use and also as operating instructions for the equipment you will use. Instead we will give you a general overview of some of the factors important to color print processing.

SOLUTIONS

Color print processing chemicals are supplied in prepared form. Kits are available, and the individual components can be obtained separately in various sizes. **Eastman Kodak** Company manufactures **Kodak Ektaprint** 2 Chemicals for processing **Kodak Ektacolor** 74 RC paper. The chemicals are **Kodak Ektaprint** 2 Developer and **Kodak Ektaprint** 2 Bleach-Fix and Replenisher. For basket and tank processing of **Ektacolor** 74 RC paper an optional **Kodak** C-22 stop bath may be used.

All color chemicals should be mixed by carefully following the manufacturer's directions.

When handling color chemicals you should wear rubber gloves to avoid skin irritation. Always wash the gloves before removing them.

WARNING

Read and observe the notices accompanying the chemicals.

TIME AND TEMPERATURE

Tray, drum, and tank processing of color prints requires a timer with a sweep second hand and minute hand that can be followed in the dark. The timer dial and hands can be phosphorescent.

The time required for each processing step *includes* the draining time. In each case, start draining in time to end the processing step, and start the next one on time.

The timing in an automatic or machine process, of course, is controlled by the speed at which the machine is operated and is usually a fixed characteristic of a particular machine.

The temperature of the processing solutions for color printing should be maintained at the specified temperature for a given solution. This is usually ± 0.5 °F for the developer and within a range of about 6 degrees for the other solutions and wash water. When processing by machine, the correct temperatures are maintained by the machine's heaters or heat exchangers and by a thermostatic mixing valve for the water. In tray or tank processing, the drain in the darkroom sink can be fitted with a standpipe; then water regulated to the correct temperature with a thermostatic mixing valve can be allowed to overflow from the washing tray or tank and surround the solution tanks to the level of the standpipe.

RECOVERING SILVER FROM SEASONED BLEACH-FIX SOLUTIONS

Silver recovery from spent color photographic processing solutions represents a significant means for conserving silver as a natural resource.

The **Kodak** Chemical Recovery Cartridge, Type P or Type 3, and the **Kodak** Circulating Unit, Type P, are two simple pieces of equipment designed to work together efficiently to remove valuable silver from used bleach-fix solutions.

Bleach-Fix Regeneration

The **Kodak** Bleach-Fix Regeneration Unit is designed to recover used bleach-fix solution. It is intended primarily for use with continuous color print processors.

This unit is used in connection with **Kodak** Chemical Recovery Cartridges, Type P. After the unit is installed, the bleach-fix overflow is directed from the processor tank overflow through two **Kodak** Chemical Recovery Cartridges, Type P, connected in series. Desilvered bleach-fix solution from the cartridges flows into the aeration tank, where iron in the ferrous state is oxidized back into the ferric state. An antifoaming agent is added. Overflow from the aeration tank fills the collection tank, and at intervals determined by the level control, the bleach-fix solution is pumped to a holding tank. Bleach-Fix Regenerator is added to this reclaimed solution for use as replenisher. When this procedure is completed, approximately 80 percent of the bleach-fix solution is reused.

DRYING COLOR PRINTS

After washing, which is a step of the processing, the prints must be dried. When processing is done by machine, the prints leave the machine dry. For hand-processed prints on RC paper, the prints are generally dried on air impingement dryers. RC papers *cannot* be dried by placing the emulsion side in contact with a ferrotype or textured dryer surface, because the moisture present in the emulsion cannot escape through the base.

Squeegeeing both sides of the prints will minimize the drying time, but care should be taken to avoid abrasion of the emulsion surface. Squeegeeing also helps prevent uneven drying patterns.

PROCESSING FAULTS

Several variables in processing can adversely affect the quality of color prints. Some of the more common causes underlying poor quality are:

- lack of cleanliness
- incorrect mixing of solutions
- incorrect use of solutions
- contamination of solutions
- lack of adequate control in the processing procedure

When prints from good quality negatives are not everything you expect them to be, check the table of color print troubleshooting in **Kodak** publication E-66; *Printing Color Negatives,* for possible causes.

MAKING BLACK AND WHITE PRINTS FROM COLOR NEGATIVES

When color negatives are printed on black and white paper the increase in apparent grain and the balance of tones in the black and white print are often unsatisfactory. This is because regular black and white printing papers are sensitive mainly to blue light. In other words, these materials "see" a color negative as though it had a blue filter over it. As a result, objects that were red in the original scene print too dark, and objects that were blue in the scene print too light. For example, red lips and ruddy complexions are too dark, blue eyes are too light, and blue skies with white clouds lack detail.

When a color negative is printed on black and white **Kodak Panalure** paper—which is sensitive to red, green, and blue light—all the colors in the picture are rendered in appropriate tones of gray. The effect is then similar to that obtained when a print is made from a panchromatic black and white negative onto a regular black and white paper.

USING FILTERS WITH KODAK PANALURE PAPER

A feature of **Panalure** paper is that you can use filters during the printing exposure to alter the balance of tones at will. In this way, you can get effects similar to those obtained by using filters over the camera lens. For minor changes in tonal balance, **Kodak** Color Compensating Filters can be used. For more abrupt changes or dramatic effects, use the same filters as for ordinary camera work.

To lighten the gray tone rendering of a color, use a filter of a color similar to that of the original object in the scene. To darken rendering, use a filter of a color complementary to that of the object. Remember, however, that when you change the rendering of one color, you also change the rendering of other colors in the scene. For example, if the subject in a portrait has deep red lips and blue eyes, the lips may be too dark in the black and white print. You can lighten the lips with a red filter, but at the same time you darken the eyes. In a case such as this, a CC40 red filter yields about the maximum correction that can be applied without making the eyes too dark. If you require a strong orthochromatic rendering, use two CC50 cyan filters over the enlarger lens.

SAFELIGHT

Kodak Panalure paper can be handled in the light of a **Kodak** Safelight Filter No. 10 (dark amber) in a suitable safelight lamp with a 7 1/2-watt bulb kept at least 4 feet from the paper. Be sure to use this safelight or a **Kodak** Safelight Filter No. 13 (amber), or equivalent, with a

15-watt bulb, or process the paper in total darkness, because the safelights normally used for processing black and white papers will fog Panalure paper.

EXPOSURE

The exposure needed for an average color negative printed on black and white **Panalure** paper is between 5 and 10 seconds with normal enlarger illumination at a magnification of 2X. To find correct exposure, make a step test on a strip of **Panalure** paper, and use 7 seconds as the midpoint in the series of test exposures.

DEVELOPMENT RECOMMENDATIONS

Because the level of safelight illumination is too low, **Kodak Panalure** papers cannot be developed by inspection in the same way as ordinary black and white papers. Development must be by time and temperature correlation.

The emulsion of Panalure paper is designed to yield normal contrast black and white prints from average color negatives. Occasionally, however, the contrast may be too high to suit your needs.

MAKING TRANSPARENCIES FROM COLOR NEGATIVES

By using color printing materials on a transparent film base, you can make brilliant color transparencies from color negatives as easily as you made color reflection prints. You follow similar exposing and processing techniques. The resulting transparencies will be equal in quality to camera exposed reversal film originals, and you have the choice of making them larger, smaller, or the same size as the original negative.

KODAK EKTACOLOR PRINT FILM

Two Kodak materials are available for making color transparencies from color negatives. **Kodak Ektacolor** print film can be used to make contact or enlarged transparencies. **Kodak Ektacolor** slide film can be used to make same size transparencies from 35mm negatives or reduced transparencies from negatives that are larger than 35mm.

The two products are similar and can be exposed in the same way as **Ektacolor** 74 RC Paper. Both are developed by using **Kodak** Process C-22 chemicals. Two or more sheets of processed Ektacolor Print Film can be joined to make large size display transparencies; **Kodak** Pamphlet No. E-58, *Preparing Large Transparencies on* **Kodak Ektacolor** *Print Film,* contains further information and is available on request from the **Eastman Kodak** Company.

Because **Ektacolor** print film is more commonly used than **Ektacolor** slide film, this section discusses the print film only. Preparing 35mm slides and filmstrips on **Kodak Ektacolor** slide film is fully discussed in **Kodak** Data Book No. S-30, *Planning and Producing Slide Programs.*

EXPOSURE

The same enlarging equipment and filters used to expose color paper can be used to expose **Ektacolor** print film.

The exposure time varies, depending upon factors such as the subject matter and negative density. However, a typical color negative or internegative may require 10 to 20 seconds' exposure. The emulsion side of the **Ektacolor** print film should face the emulsion of the color negative.

As with color paper, variations in speed and color balance are unavoidable from one emulsion number to another of **Ektacolor** print film. It is difficult, therefore, to suggest accurate exposure and filter information for making transparencies from a negative for which the color paper filter pack and exposure time are known. Generally, however, the speed of the print film is one to two stops less than the speed of color paper, and the filter pack for transparency printing, although similar to the pack used for printing on paper, may require additional magenta filters. Filters and exposure recommendations for individual emulsions are given in the data sheet packaged with the film.

Processing

Chemicals for processing solutions are supplied in prepared form in the **Kodak** Color Processing Kit, Process C-22. Prepared chemicals to make the individual solutions are also available.

Complete processing instructions are included with processing kits and developer packages.

PRINTING COLOR FILMS DEVELOPED AS BLACK AND WHITE

When color films have been mistakenly processed as black and white, there are several ways you can salvage pictures from them. You can obtain black and white prints from your films, or you can obtain color prints or color slides from them (except **Kodachrome** films).

These prints or slides would not be acceptable *compared* with those from color films which have been processed correctly. But the salvaged prints should certainly be of value especially when you can't make the pictures over again.

BLACK AND WHITE PRINTS

When color films are processed accidentally as black and white, they usually have an overall yellow or orange stain along with a black and white image.

The stain in the negatives from color films is reddish orange and is similar to the overall reddish orange color of negatives when the films are properly processed as color negatives. Therefore, you can make black and white prints from these films without giving the negatives special treatment. Kodak Penalure paper is best for making black and white prints from these "color" negatives.

When color transparency film is processed as black and white, the black rem-jet backing may not have been removed. To remove the rem-jet backing, swab the film with cotton dipped in a mild alkaline solution—a 5-percent solution of sodium carbonate will do the job. Try to keep this solution off the emulsion side of the film. Rinse the film to remove the sodium carbonate.

You can make prints from these "slides" on Panalure paper, but if you remove the yellow or orange stain from these misprocessed films, you can print the negatives on conventional black and white paper the same as you would any normal black and white negatives. *Do not remove the stain from Ektachrome films if you plan to reprocess them as color negatives.*

To remove the stain from Kodachrome and Kodak Ektachrome films, except High Speed Ektachrome film:

1. Prepare a bleaching bath by dissolving 1 ounce of citric acid, crystals (monohydrated), in 1 gallon of **Kodak** Rapid Fixer diluted as recommended for films in the fixer instructions.
2. Handle only one negative at a time. Treat the negative in a wetting solution at 75-80 °F for 1 minute. Use fresh solution prepared as directed on the label.
3. Rinse in water at 75-80 °F for 20 seconds.
4. Immerse in the bleaching bath at 75-80 °F for 7 to 14 minutes.

IMPORTANT: Stop bleaching if reduction of the silver image becomes apparent. It is better to leave a little stain than to lose the silver image.

5. Wash the negative thoroughly in running water at 75-80 °F for 10 minutes.
6. Remove water droplets with a soft, viscose sponge or treat the film with wetting solution for 1 minute. Dry the negative.

Print the negative as you would any normal black and white negative.

To remove the stain from High Speed **Ektachrome** film:

1. Prepare a prehardener bath:

Water	64 fl oz
Formaldehyde, about 37% solution by weight	4 fl oz
Borax (decahydrated)	5 1/4 oz
Water to make	1 gallon

2. Prepare bleaching bath:

Water	97 fl oz
Hydrogen peroxide (30%)	13 fl oz
Sulfuric acid (7%)	18 fl oz

Always add the sulfuric acid to the solution slowly, stirring constantly. NEVER add the water or solution to the acid.

3. Place the film in the prehardener bath at 75-80 °F for 5 minutes. Agitate every 30 seconds.

4. Wash in running water at 75-80 °F for 5 minutes.

5. Bleach the film in the bleaching bath at 75-80 °F for 4 minutes. Agitate every 30 seconds. This step may be repeated if removal of the stain is not sufficient.

6. Wash in running water at 75-80 °F for 5 minutes.

7. Remove water droplets with a soft, viscose sponge or treat the film with wetting solution, prepared as directed on the label, for 1 minute.

Print the negative as you would any normal black and white negative.

CAUTION

Avoid unnecessary or prolonged skin contact with the prehardener or the bleach. Use rubber gloves. In case of accidental skin or eye contact, flush the affected area with plenty of water immediately. Contact with the liquid or vapor of the prehardener may cause skin and eye irritation. Provide adequate ventilation. Keep tanks covered when you are not using them.

COLOR PRINTS OR COLOR SLIDES

If you want color prints or color slides from your misprocessed films, except Kodachrome films, you can bleach and process the negatives to obtain color negatives. In many cases, this procedure will restore reasonable color images to the negatives so that color prints or slides can be made from them.

It is impossible to predict whether the color pictures you obtain will be acceptable. There is an infinite number of black and white developers and process conditions which would have a direct effect on the final results. However, the color prints or slides that have been salvaged with this emergency procedure should have more value than black and white prints from the same negatives.

The procedures described for salvaging pictures in color are not recommended for Kodachrome films. Only black and white prints can be made from Kodachrome films which have been misprocessed as black and white.

When you want color pictures from your films, do not use the procedures for removing stain that were described for making black and white prints.

Before you reprocess your negatives to obtain color, it's a good idea to make the best possible black and white prints for "insurance." Because of the yellow or orange stain in the negatives, make your "insurance" prints on Panalure paper. Otherwise, the exposure time would be excessively long on conventional black and white papers.

For reprocessing your films in color, use the Kodak Color Processing Kit, Process C-22. You can carry out all the steps in normal room light.

1. Wash—15 minutes at 73-77 °F.

2. Bleach in **Kodak** Bleach, Process C-22—8 minutes at 73-77 °F. (The bleach must be free of hypo. If in doubt, use a fresh bleach solution.)

3. Wash—15 minutes at 73-77 °F.

4. Expose to the light from a No. 2 photoflood lamp at a distance of 1 foot for 15 seconds on each side. Even though the preceding steps were done in room light, the exposure may have been uneven.

CAUTION

A lighted photoflood lamp becomes very hot and will shatter if you allow any liquid to splash on its surface. Place sheets of glass where they will protect the lamp from spattering or splashing of the solutions or the wash water.

5. Develop in **Kodak** Liquid Developer, Process C-22—12 minutes at $75 \pm 1/2$ °F.

6. Complete the remaining steps in Process C-22. See the instructions that come with the processing kit.

Now that you have reprocessed your films as color negatives, you can make color prints on color paper or color slides on slide film.

COLOR PRINTS FROM COLOR TRANSPARENCIES

Color prints can be made directly from color transparencies (slides) without the time and expense of making an internegative. This is done

by the use of reversal color paper such as Kodak Ektachrome paper. Reversal color paper, like reversal film, when exposed to the subject (in this case a slide), produces a positive color image of the slide.

Modern color photographic materials represent the best efforts of photographic manufacturers and are made to very exacting standards and quality levels. Unfortunately, these efforts can be negated by improper handling by the end user of such products.

The quality of a print can only be as good as that of the transparency from which it was printed. Originals which have been poorly exposed or processed, or which are damaged or dusty will rarely give satisfactory prints.

It must be recognized that the conditions under which the original transparency was exposed, processed, and handled greatly influence how that transparency will reproduce on any material. Color film is manufactured to produce pleasing pictures when exposed to light of a certain color quality and illumination level. Photographers should be aware that light that starts out at the correct color temperature may not reach the film at the same color temperature due to a variety of factors. Discolored or dirty reflectors or flash shields, tinted camera lenses or condensers, and reflection of light from highly colored surfaces, such as walls or grass, can all affect the color quality of the illumination used to make color photographs.

Exposure at shutter speeds beyond the range for which the film was designed can cause uncorrectable color reproduction errors, as can nonstandard or out of tolerance film processing conditions. Even though a film was exposed and processed exactly as intended, color reproduction errors can be induced by improper handling before processing. Exposure to high levels of heat and/or humidity can cause problems as can long periods of time elapsing between exposure and processing.

Transparencies which are old or have been stored under adverse conditions are likely to have faded to some degree and this fading may not have been equal overall. This can be a real problem in printing. Duplicate transparencies generally vary widely in quality and can be a problem when trying to make high quality color prints.

The lighting ratio used for the original photograph has a great deal of influence on the overall reproduction, as it is the lighting ratio that determines, in part, the contrast level of the transparency. No reflection color print material presently available can fully reproduce the contrast range that a transparency, viewed by transmitted light, can produce. Therefore, careful lighting of the original subject should be considered.

You must consider the conditions under which the print and transparency are evaluated. It is imperative that the quality of the light falling on the reflection print be exactly the same as the light that is used to illuminate the transparency. The photographic community has standardized on 5000 °K as standard viewing conditions for color materials. However, as a matter of practicality, any light source can be used providing the "Color Rendering Index" is 90 or better. Therefore, deluxe cool white fluorescent lamps having a CRI of about 90 are acceptable for evaluating color, even though the color temperature is only 4200 °K. On the other hand, a white fluorescent lamp has a CRI of only 60, and, therefore, is not suitable for viewing color. The intensity of the illumination used to evaluate prints is important as well and should fall within the limits of 130 ±55 footcandles.

Finally, another practical consideration is that the print should be evaluated under the same viewing conditions as it will be displayed. Obviously a print to be hung in a dark, tungsten illuminated office must be lighter and "cooler" than a print to be displayed in a bright, daylighted environment.

STANDARD TRANSPARENCIES

In reality, there is no such thing as an "absolute standard transparency." There can only be, by definition, "relative standard transparencies." You must decide, within certain guidelines, essentially what a useful standard transparency is for your reproduction system. For your guidance, we can give a general definition of a relative standard transparency:

> A relative standard color transparency is one that is *subjectively* representative of the user's normal input and that has been exposed using the correct lighting conditions and spectral quality specified by the film manufacturer and required by the user. It must have been processed strictly according to the manufacturer's recommendations and stored and protected consistent with good practice and recommended conditions.

In printing color reversal papers the system produces positive color images. The exposed reversal color paper is developed in a special black and white developer which produces a negative silver image in each of the three emulsion layers. The paper is then reexposed to a bright light in order to fog the remaining silver halides and render them developable, or the paper is chemically "fogged" in the color developer. The latent positive image is then dye coupler developed to form three positive dye images: yellow, magenta, and cyan. The silver is then bleached from the paper and the dye images remain. The three dye images alter and reflect the light used to view the print so that a full color positive image of the original scene is seen.

> Another way to make full color prints directly from color transparencies is by the dye destruction color process. The only direct positive color materials currently manufactured which employ this process are Cibachrome products. This process will be be discussed in the next section of this chapter.

The principles of making color positive prints from color transparencies are the same whether coupler development or dye destruction materials are used. Colored filters are used to alter the printing light to obtain proper color balance, much the same as is done in printing color negatives.

EQUIPMENT

Reversal color paper is exposed with enlargers designed for printing color negatives. The enlarger should be equipped to hold color printing or color compensating filters or to use dial in filtrations such as dichroic filters. Various reversal papers have different requirements for ultraviolet (UV) and infrared (IR) cutoff filters, and the data sheets accompanying the different paper should be consulted to determine these requirements.

An infrared cutoff filter must be placed in a perpendicular position to the enlarger's optical axis and close to the light source in a specular, parallel part of the light beam. If light is passed through the IR cutoff filter at an angle, changes to the spectral quality of the filter will result.

Voltage regulation for the enlarger is just as

color negatives. Therefore, a voltage regulator should be used. Some color enlargers which have tungsten-halogen lamps have a built-in stepdown transformer which acts like a voltage regulator.

MAKING THE FIRST PRINT

For making your first color print on reversal paper you should select a transparency that has been correctly exposed with light of the correct color quality and intensity. This will become your "standard transparency". This standard transparency should be on the same kind of film you regularly use. Even better, make several standard transparencies on the different color reversal films you will use. These standard transparencies will be used to arrive at standard filter packs for various paper emulsions.

To make your first or test print:

1. Set up the enlarger with the required UV and IR cutoff filters.
2. Place a clean, dust-free transparency, removed from its mount, into the enlarger with the transparency's emulsion toward the lens. Mask the transparency to eliminate any stray light from escaping from around its edges.
3. Remove all color balancing filters from the enlarger light beam to give a filter pack designation of 0 cyan, 0 magenta, and 0 yellow.
4. Adjust the enlarger for an 8×10 print of a 35mm slide. Set the lens at f/5.6 and make a series of exposures at 10, 20 and 40 seconds.
5. Process and dry the test print.
6. View the test print and estimate the filter pack and exposure adjustments required and make another test print at the selected filter pack and exposure time and f/stop. Process and dry this test print. Continue this test printing until you are satisfied with your results.
7. When you are satisfied that the color balance and density are correct, record the exposure and filter pack information as your "printing standard" for the type of transparency used as the standard transparency. Assuming the printing conditions, size of enlargement, and paper emulsion number remain constant, all other transparencies which are similar to the standard transparency should produce equally good prints.

The printing standard you determine for your first standard transparency can be used to help you arrive at a printing standard for your other

printing standard as the starting point for other printing standards.

Evaluating Test Prints

The same viewing conditions which were discussed for viewing test prints from color negatives are suitable for evaluating reversal color prints. However, when comparing a reversal color print to the transparency from which it was made the transmission and reflection light sources should be equal in color temperature.

The density range of a color print is much lower than that of a transparency viewed by transmitted light. Prints, therefore, should be evaluated for density not by comparing them to the transparency but by examination of highlight and shadow densities. Remember, just like exposing reversal color film, in making exposure corrections for reversal paper, add exposure time or intensity (f/stop) to make a lighter print; subtract time or intensity to make a darker print.

The easiest way to evaluate the color balance of a reversal color print is to compare it to the original transparency. Judge the middle tones to see variations of color in the middle tones of the transparency. If it is hard to determine the color that is in excess, view the print through filters such as those in the Kodak Color Print Viewing Filter Kit. In printing reversal color paper, the filter which makes the print look best represents the correct color to *add* to the printing light. This is unlike printing color negatives where the color of the filter which makes the print look best is *subtracted* from the light.

Use the following table to help you determine filter pack changes for color reversal paper.

Filter Pack Adjustments
for Reversal Color Printing

If the color balance is:	Subtract these filters:	or	Add these filters:
Red	Yellow and Magenta		Cyan
Green	Yellow and Cyan		Magenta
Blue	Magenta and Cyan		Yellow
Cyan	Cyan		Yellow and Magenta
Magenta	Magenta		Yellow and Cyan
Yellow	Yellow		Magenta and Cyan

When making changes to the filter pack, *remove* filters whenever possible; e.g., if the test print has an excess blue color, remove magenta and cyan filtration rather than adding yellow.

The filter pack should not contain more than two colors of the subtractive filters (yellow, magenta, and cyan). When all three colors are in the filter pack the effect is neutral density which only serves to lengthen the required exposure time. Neutral density is eliminated by removing the filter of one color completely, and then removing the same density of each of the other two colors. For example; assume the filter pack you came up with was 46Y + 38M + 12C. You would completely remove the cyan filteration plus 12Y and 12M. Thus your adjusted filter pack would be 34Y + 26M.

As compared to printing color negatives, printing color transparencies takes a greater change in filter pack to accomplish the desired result.

EXPOSURE ADJUSTMENTS.—Whenever you change the filter pack, allowance should be made for a change in exposure caused by the change in filtration action, and the change, if any, in the number of filters. If allowance for these changes is not made the density of the reprint will differ from that of the test print.

The following table gives appropriate filter factors which will help you calculate the correct exposure.

Filter Factors for CC and CP Filters

Filter	Factor	Filter	Factor
05Y	1.1	05R	1.2
10Y	1.1	10R	1.3
20Y	1.1	20R	1.5
30Y	1.1	30R	1.7
40Y	1.1	40R	1.9
50Y	1.1	50R	2.2
05M	1.2	05G	1.1
10M	1.3	10G	1.2
20M	1.5	20G	1.3
30M	1.7	30G	1.4
40M	1.9	40G	1.5
50M	2.1	50G	1.7
05C	1.1	05B	1.1
10C	1.2	10B	1.3
20C	1.3	20B	1.6
30C	1.4	30B	2.0
40C	1.5	40B	2.4
50C	1.6	50B	2.9

When the enlarger is equipped with yellow, magenta, and cyan dichroic filters, filter factors are not required.

To use filter factors: Divide the old exposure time by the factor for any filter removed from the pack. Then multiply the resulting time by the factor for any filter added to the pack.

For two or more filters, multiply the individual factors together and use the product.

Adjusting Filter Packs for Changes in Paper Emulsions

As with color paper for printing color negatives, when you use reversal color papers with different emulsion numbers, an adjustment to the printing standard filter pack must be made.

The package label of reversal color paper or the instruction sheet for the paper gives the "filter correction" values for that particular emulsion number. The filter corrections may contain both + and − values.

Filter calculations are made easier by converting all filters to their equivalents in subtractive colors, if they are not already of the subtractive colors (for example; 20R = 20M + 20Y). Also, filters of like colors should be added together in the calculations (for example; 10M + 20M = 30M).

1. Determine the basic filter pack by subtracting the filter correction printed on the label for the old emulsion from the filter pack used for that emulsion.

Example: Step 1: Suppose the filter pack required for the old emulsion was 10C + 05Y, and the filter correction printed on the package label of that emulsion was +10C −25M −05Y. Set up these values as follows:

Filter pack used for the old emulsion	10C	0M	05Y
(Subtract) old emulsion filter correction value	+10C	−25M	−05Y
To simplify the subtraction of minus values, follow this rule: "Change all the signs of the values to be subtracted and proceed as in addition."	+10C	0M	+05Y
	-10C	+25M	+05Y
	0C	+25M	+10Y
	(basic filter pack)		

2. Determine the filter pack required for the new emulsion by adding the filter correction value printed on the label for the new emulsion to the basic filter pack.

Example: Step 2: Suppose the filter correction value of the new emulsion is −05C +25M −20Y.

Basic filter pack			
(Add) filter correction value	0C	+25M	+10Y

3A. If negative filter values are present in the pack, add (by calculation) C, M, and Y "neutral density" equal to the largest negative filter. In this way, one of the three filters will become zero. Look up the neutral density factor in Section A of the following table.

Neutral Density Factors

CC Neutral Density Added in Step 3A or Subtracted in Step 3B	Section A	Section B
5	1.1	.89
10	1.3	.77
15	1.4	.70
20	1.6	.62
25	1.8	.54
30	2.1	.48
35	2.3	.43
40	2.6	.38
45	3.0	.33
50	3.4	.29
55	4.5	.22
60	5.6	.18
65	7.0	.14
70	8.3	.12
75	9.5	.10
80	10.7	.093
85	11.7	.085

Example: Step 3A: Since negative filter values are present in the pack, add 10 neutral density (+10C +10M and +10Y) to these values.

Preliminary filter pack	−05C	+50M	−10Y
(Add) neutral density	+10C	+10M	+10Y
Final filter pack for new emulsion	+05C	+60M	0Y

Look up a 10 neutral density in Section A of the table above. The neutral density factor comes out to 1.3 in this case.

or

3B. If all the filter values are positive, subtract C, M, and Y "neutral density" equal to the

three will now be zero. Look up the neutral density factor in Section B in the table.

or

3C. If the filter values are positive and at least one is zero, go to Step 4. Your neutral density factor is 1.0.

4. Calculate the new exposure time by the following formula:

$$\text{Exposure Time for the New Emulsion} = \text{Exposure Time for the Old Emulsion} \times (\text{Neutral Density Factor})$$

Example: Step 4: Suppose the exposure time used for the old emulsion was 8.5 seconds and the neutral density factor is 1.3. Calculate the new exposure time by the formula:

$$\text{Exposure Time for the New Emulsion} = \text{Exposure Time for the Old Emulsion} \times (\text{Neutral Density Factor})$$

$$\text{New Exposure Time} = 8.5 \times 1.3$$
$$= 11 \text{ seconds}$$

This is the exposure time that should be tried for the new emulsion.

5. Use the new filter pack and the printing times calculated as a starting point for a series of test prints using a standard transparency.

SILVER-DYE BLEACH (DYE DESTRUCTION) COLOR PRINT PROCESS

In conventional, chromogenic reversal color, the image forming dyes are produced during development by built-in colorless couplers which react with products of the developing agents. These papers require a reversal process using two developers and an intermediate exposure or an equivalent chemical reversal step.

In the silver-dye bleach process, image dyes are added to the emulsion layers during manufacture. During processing, they are removed (bleached) from the emulsion layers in the areas where they are not required. This process requires only one developer and no intermediate exposure. The only commercially available silver-dye bleach process available at the time of this writing is the Cibachrome process.

STRUCTURE OF SILVER-DYE BLEACH MATERIALS

Cibachrome color paper and display film have an identical emulsion layer structure, the essential difference is the support. Cibachrome II Pearl Paper uses a resin-coated paper base, Cibachrome II Deluxe Glossy is coated on white opaque polyester, and Illford Cibachrome II Display Film is a transparent polyester base. All the Cibachrome materials have nine layers arranged as follows:

9—Supercoat
8—Blue sensitive emulsion layer without dye
7—Blue sensitive emulsion layer with yellow dye
6—Mask-interlayer
5—Green sensitive emulsion layer without dye
4—Green sensitive layer with magenta dye
3—Gelatin interlayer
2—Red sensitive emulsion layer without dye
1—Red sensitive emulsion layer with cyan dye
Base (RC paper, opaque polyester or transparent polyester)
Backing layer

There are two light sensitive silver halide emulsion layers responding to each of the three primary colors. Only one layer contains the appropriate image dye. The dye-free layers (2, 5, 8) influence the bleaching of the adjacent dyed layers (1, 4, 7) and so increase the photographic speed without increasing the contrast.

The masking layer (6) between the blue and green sensitive layers controls the bleaching process of the yellow dye in the blue sensitive emulsion layer depending on the exposure of the green and red sensitive layers. With this interlayer effect, a mask is formed which improves the color rendition.

PRINTING WITH SILVER-DYE BLEACH MATERIAL

Any good quality enlarger equipped with a color corrected lens and a filter drawer or a color head having a suitable light source (halogen, projection lamp or pulsed xenon with proper correction filter) can be used to expose

Cibachrome materials. An ultraviolet absorbing filter must always be inserted in the light path.

When using Cibachrome as with conventional reversal color papers, you should have available a standard transparency which can be used to evaluate the entire photographic reproduction system. When using Cibachrome materials the following considerations should be kept in mind:

- Different types of color film will reproduce differently on Cibachrome materials; i.e., will require different filter packs.

- Transparencies of inherent low contrast will reproduce more faithfully than those of high contrast.

- Enlargements of great magnification will appear to be visually lower in contrast than small enlargements.

- Due to the direct positive characteristics of Cibachrome materials, small scratches and dirt on the transparency will be more apparent in the final product than with negative/positive photographic printing materials because they show as black defects which are more difficult to retouch.

- It may not be possible to fully correct in printing, transparencies that have an overall tint or color cast due to improper film exposure and/or processing.

- Particular care should be exercised in the printing of high key transparencies. Be sure that there is sufficient density in the main subject to reproduce on Cibachrome materials.

- Understand that you may never totally match all areas of the print or transparency to the original unless you are willing to use supplementary printing techniques such as dodging and burning in and/or area color correction (retouching).

Color Correction Filtration

No special filters are required for Cibachrome materials. The usual photographic printing filters, as well as color enlargers, can be used. In addition to the color filters, an ultraviolet absorbing filter must always be inserted in the light path.

On the label of each pack or roll of Cibachrome material will be found a standard filtration for that particular emulsion. It refers to Kodak CC filters. These filter values were established under certain standard conditions; they cannot necessarily be used as absolute values for a given situation. However, they are a useful guide when changing from one emulsion number to another. The new filtration can be found more easily, thus reducing the amount of time and material wasted.

Color correction techniques using CC or CP or dichroic filters and Cibachrome materials are the same as when using other reversal color papers.

Processing

Cibachrome materials must be processed in Cibachrome processes P-3, P-18, or P-30, depending on the specific material to be processed.

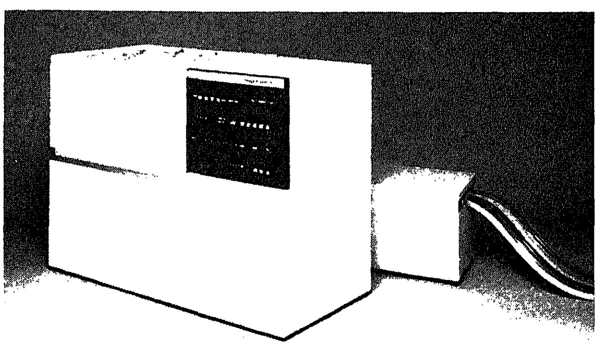
Further information on Cibachrome materials may be obtained by asking for the Illford publication "*Technical Information, Cibachrome II*", available from Illford Inc., West 70 Century Road, Paramus, NJ 07652.

CHAPTER 6

MACHINE PROCESSING AND LABORATORY EQUIPMENT MAINTENANCE

Photographic processors are either automatic or semiautomatic systems used in place of manual processing in order to process a greater volume of film or paper in less time with more consistent results. Semiautomatic processors require the darkroom worker to move the material being processed from solution to solution and to remove the processed material from the processor for drying. The processing sink, shown in chapter 5, for basket processing of color paper is a semiautomatic processor. Some semiautomatic processors are suitable for small darkrooms or low-volume application and use hand-loaded reels, tubes, drums, and baskets to hold the film or paper being processed. Some of these have a provision for automatically timing each step of the entire process.

In this chapter we are concerned with the truly automatic processing machine only. With automatic processing machines, the person operating the processing machine does little more than feeding the film or paper into the machine and retrieving the finished product.



Courtesy KingConcept

Universal semiautomatic black and white and color film and print processor.

In Navy photo labs, we have always had a need for a good laboratory equipment maintenance program. However, with more and more semiautomatic and automatic machines being used the need for maintenance has become even more critical. Poor equipment maintenance is probably the major cause of machine processing problems. The ever increasing complexity of processors and other lab equipment and the advancing age of some equipment require that you learn laboratory equipment maintenance.

PROCESSING MACHINES

Fully automatic film and paper processing machines have automatically controlled temperature, timing, and cycling. The latest and most modern processors are computer controlled. Other processors may be controlled by magnetic tape, punched cards, disks or tape, and electromechanical timer/thermostat devices.

Your job as an operator of automatic processing machines is to start the machine, feed in the material to be processed, remove the finished product, and stop the machines. Sounds simple? Well there is just a bit more to it. As a machine operator you may also have to prepare the chemistry for the processor, monitor results and perhaps make adjustments to the machine, and perform both preventive and corrective maintenance. At the very least, you have to keep the processor clean.

Automatic processors commonly use roller transport systems. Machines designed specifically for processing long lengths of motion picture film use a sprocket drive system, or the film may

Courtesy Eastman Kodak Co.

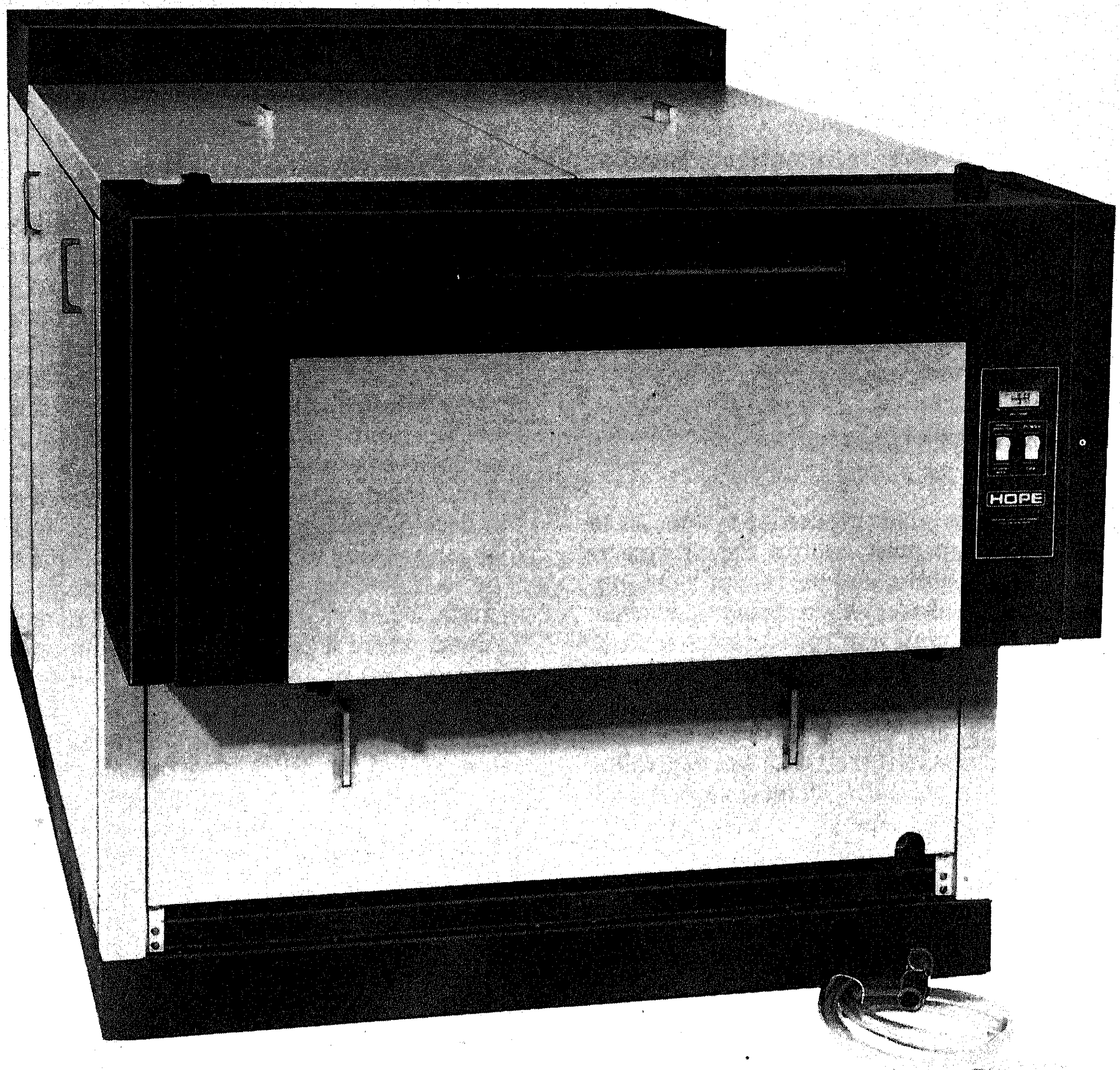
Automatic black and white film processor.

be pulled through the machine by a leader strip spliced to the film.

The greatest speed and efficiency in processing is achieved when materials are in continuous long length—print paper in rolls up to several hundred feet long; or short rolls of film taped together to form greater lengths.

In an automatic processor the material being processed is moved at a constant speed. The size of the solution tanks and the length of the path through the solution determine how long the material remains in each solution, and, thus, the processing time. As the finished, dry, processed material leaves the processor, other equipment may automatically trim, mount, sort, or even caption or annotate the material.

Many different types of processors are in use throughout the Navy. Each type has specific installation, operation, and maintenance instructions supplied with it. Therefore, in this section we will not discuss any one processor, but



Courtesy Hope Industries, Inc.

instead will present general information which may apply basically to many machines.

SERVICE REQUIREMENTS

The layout and size of the area where a processor is to be used varies depending upon the design of the machine and the needs of the particular audiovisual activity. A recommended layout, along with information regarding processor dimensions, drain locations, etc., is always provided with the processor.

Aside from the space the processor occupies, space must be allowed to operate the machine and service it, and for feed tray and takeup operations, replenisher tanks, sinks, exhaust systems, and other requirements.

PROCESSOR SYSTEMS

In any photographic processing system (hand or machine), you must control the processing time, the temperature, and the rate of agitation. In addition to these, when using automatic processors, you must control variables such as solution recirculation, solution filtration, solution replenishment, carryover of solutions from one tank to another, and film or paper drying. Each of these processing variables is controlled separately. But, remember, all these variables are interdependent. For example, if you determine that a specific feet-per-minute rate is desirable, this rate, other factors remaining constant, is correct for only a particular developing temperature. If the temperature goes up, the developer becomes more active and the temperature must be reduced or the feet-per-minute rate must be increased. In this example we only considered two variables and one was balanced against the other. A third variable, such as replenishment, may now have to be balanced against the other two variables which are now considered as standards; and so on through the list. What you do to any one variable influences the rest, and then all this must be balanced against other variable factors that are not a part of processing, such as change in film or paper type, haze encountered during the mission, or scene characteristics.

Transport Speed

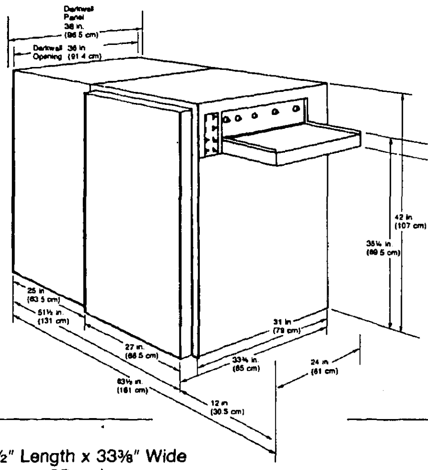
As a processing machine operator, one of your prime considerations is the processor transport speed. Unlike hand processing where developing time is measured in minutes and seconds, machine processing developing times are measured in feet-per-minute. Even though different terminology is used, both methods measure the length of time the material is subjected to the developer and other solutions.

The time that the solutions are allowed to act on the film or paper is the result of the speed at which the machine moves the sensitized material and the length of material immersed in a particular tank at a given instant. Most machines have an indicator which shows the number of feet of film or paper passing through the machine per minute. The temperatures of solutions and the specific number of feet in each section of the machine are constant factors, usually. Therefore the rate the paper or film travels will determine the development time, fixation time, washing time, and drying time. For example, if the speed is set to 10 feet-per-minute, a certain point on the material being processed will take 3 minutes to go from where it enters the developing tank to where it leaves the developing tank if the tank contains 30 feet of film. Thus, there is a correlation between the rate of travel, the tank capacity, and the developing time. We can state the problem another way. If the tank contains 30 feet of film, the developing time at 10 feet-per-minute is 3 minutes.

Thus: $30 \div 10 = 3$

ACCESS TIME.—Two widely discussed and perhaps misunderstood factors relating to any processor are speed and access time. Regardless of the machine speed; e.g., 10 to 100 fpm, film or paper can't be processed faster than the total required solution times. For example, let's assume we are processing a given film and the required processing and drying time for this film is 10 minutes and 20 seconds. Thus, when the processor is loaded and processing this film, it will be 10 minutes and 20 seconds before the first foot of film leaves the processor. However, the time for obtaining various lengths of film once the process times are met is in direct relation to the machine

RT-2014
SPECIFICATIONS



Dimensions
42" High x 63½" Length x 33⅜" Wide
(107 cm x 161 cm x 85 cm)

Weights
Shipping 725 lbs (330 kg), Operating 900 lbs

Power Requirements:
240v, 16 amp, 60 Hz, 3450 watts;
220v, 15.2 amps, 50 Hz, 3165 watts

Transport Speed:
14 inches per minute

Dry-to-Dry Time
11 minutes

Tank Capacities:
Developer 14.5 gallons, Bleach Fix 7 gallons, Wash 14 gallons

Construction: Stainless steel and polyethylene

Production Capacity Approx

3 x 5" prints	600	8 x 10	175
4 x 5	525	11 x 14	65
5 x 7	300	16 x 20	45

ACCESSORIES	Part No.
Water Mixing Valve & Thermometer	554-18002
Replenisher Storage Tanks (2 required)	525-18023
Drip Tray	554-781
Splash Guard	554-782
Roll Feed and Take Up	554-18001
Cleaning Tank	554-18012
Rack Hoist Group	554-18010
All Temp Water Filter (2 required)	58-199
Transformer Installation Kit	554-18003
Motor Transformer Accessory	89874
Feed Guide Group 3½ -inch	554-18004
5-inch	554-18005
8-inch	554-18006
10-inch	554-18007
11-inch	554-18008
16-inch	554-18009
20-inch	*554-546
Take up flange group	21-70

* (clamp only, guide built into table)

Specifications subject to change without notice.

pako®
PAKO CORPORATION
6300 Olson Memorial Highway • Minneapolis, Minnesota 55440

speed. If the machine speed is 10 fpm, then a 10-foot roll or section of film will take 10 minutes, plus 20 seconds, plus 1 minute. With a 200-foot roll, access time will be 10 minutes, plus 20 seconds, plus 20 minutes. However, if faster access time is important, and if process time requirements are to be met, then the processor will have to run at a faster speed and thus be larger to accommodate more film per tank than a processor operating at 10 fpm.

Water Temperature and Flow Rate

Another important processing consideration is that of the wash water. Not only is the temperature important, but also the flow rate. Two aspects of the waterflow rate must be considered. These are:

- Sufficient flow to ensure complete material washing.
- Control of the waterflow to eliminate waste.

The importance of material washing is discussed in chapters 3 and 4 of this module. However, it must be remembered that the washing factors previously discussed also apply to machine processing.

In any photographic processing cycle, two factors relating to material washing are of special concern. The first of these is the temperature of the wash water. Most photographic materials are most effectively washed when the wash water is about 75 °F. However, care must be exercised during machine processing since, in many instances, higher solution temperatures are used to speed up the processing cycle. When such is the case, the wash water temperature should also be increased since large differences in the temperatures of the developer, fixer and wash may cause emulsion reticulation.

If the temperature of the wash water is allowed to drop to 65 °F or below, not only is the possibility of reticulation increased, but emulsion staining may also result. This is because as the temperature decreases, less emulsion swelling occurs, retarding the effective penetration of the emulsion by a fresh supply of wash water. When the emulsion doesn't swell, the chemical-laden water doesn't get out through the emulsion surface. When this happens, enough chemicals remain in the emulsion to eventually cause stains.

The other factor that is important in material washing is the waterflow rate. This rate must be such that the materials are sufficiently washed. If insufficient waterflow is allowed, not only will crystallized chemicals be seen on the material surfaces, but additional stains may result. However, most continuous processors are constructed so that washing uses much more water than is actually needed. Furthermore, most of us have a tendency to use excessive amounts of water to ensure that the processed material has been sufficiently washed. This act can be extremely costly, especially aboard ship. Consider for a moment a high production laboratory consisting of 10 processors that operate an average of 20 hours each day, 7 days each week. Over a period of 30 days, if a 10-gallon-per-minute flow rate is used, the total water consumption is 3,600,000 gallons. If only one-half of this amount is actually needed, and used, to wash the material, the savings could equal the lifetime needs of 100 people who live to an average age of 65.

Thus, while a few extra gallons-per-minute flow rate may not, at first, seem important, its effect can be great. Tests should be conducted to establish what flow rate will ensure archival quality. *This amount should definitely be used, BUT NO MORE.*

Selecting Processing Solutions

The selection of the correct processing solutions is just as important for machine processing as it is for hand film processing. In machine processing, the type of developer and other solutions used is determined by the type of product being processed. In most cases, because of the relatively short developing times and high operating temperatures, these solutions are specially formulated. Think about a high speed processor designed to develop high altitude aerial

reconnaissance original negative film to acceptable densities and gamma in 2 minutes or less, now can you understand why the selection of correct processing solutions is important?

SOLUTION TEMPERATURE.—Another factor is the temperature of the proccessing solutions. This is one of the most critical elements in the control of the photographic process. The speed of chemical reaction increases as the temperature of a solution is raised and decreases as the temperature is lowered. This means that higher densities and contrast will result as the temperature increases and that lower densities and contrast will result as the temperature decreases. In machine processing, the temperature may vary, depending on the machine and the kind of processing being done. High speed processing machines operate at quite high solution temperatures. Temperature control is critical and must be maintained at a close tolerance to produce correct results. Although this may be considered a variable factor, it is controlled automatically by processing machines. In some machines, the solution tanks are immersed in a temperature controlled water jacket, and controlling the water temperature within the water jacket controls the temperature of the solutions inside the tanks. In other machines, the water jacket is eliminated and the solution temperature is directly controlled by separate heater or heat exchange control units in the recirculation system. A temperature probe in the solution tank transmits an appropriate signal to the temperature control unit. In spray processing, such external heating or cooling is also used to assure that the temperature of the solution as it is expelled from the spray head is correct. Any malfunction of the temperature control will produce undesirable results.

SOLUTION LEVELS.—There is a certain amount of carryover of solution from one tank to another within the machine. Usually, chemical carryover is minimized by use of mechanical rubber roller squeegees. Air "squeegees", consisting of air jets, are generally used at the end of each wash operation to prevent carryover of contaminated water to the next wash and to remove surplus water before the film enters the drying cabinet. If this water is not removed, or if it is only partially removed, drying streaks are apt to occur on the finished product. On some machines, air squeegees may be used between two tanks containing different processing solutions if the air impingement (the high pressure air striking the surface of the film) caused by squeegee operation will not affect the efficiency of the solutions through oxidation.

In most systems, the air squeegee is simply a narrow slit through which a large volume of air passes under pressure. By forcing air against the surface of the film in this manner, most of the liquid being carried on the surface is blown back into the tank from which it came. All squeegees must operate properly if an accurate replenishment rate is to be maintained.

Any time that high velocity air is being directed against a piece of film, as it is with air squeegees, you must make sure that the compressed air supply does not contain any dust, moisture, or oil. Therefore, the air supply must be filtered. A filter which can remove oil is especially desirable if the air compressor is oil lubricated. Air filters provided with the machine should be cleaned or changed often enough to ensure that completely clean, dry air is being delivered to the air squeegee.

The developing time required is directly proportional to the depth of developer in the tank. Thus, you see how important it is that the proper solution levels be maintained and that excessive solution carryover be eliminated.

Replenishment

All of the other processing variables can be precisely controlled, and yet, the film or paper can be lost because of a haphazard or nonexistent replenishment program.

With many processing machines you will be using large quantities of the various solutions. However, even considering the large quantities involved, individual chemical components within a given solution are used up at varying rates. In addition there are certain reaction byproducts which may form in the processor's tanks. For example, bromide (a restrainer) gradually builds up in the developing solution. Also, there is a

certain amount of carryover of solutions from one tank to another. Thus, you have a continuous change in solution strength and solution purity. To correct this, you must have a system of replenishment. The solution used for replenishment must be compounded so that it will replace the used chemicals of each solution in correct proportion, and, at the same time, dilute the excess chemicals or byproducts which have built up. Also, since a certain amount of solution is lost by carryover and evaporation during processing, it too must be replaced during replenishment.

The quantities of each replenisher component must be precisely controlled. Each component should have the effect on the material being processed that it has in the basic solution formula. For instance, too much developing agent in a solution where the quantity of the other components is correct may result in an increased product density, contrast, and gross fog for any given combination of time, temperature, and agitation. Likewise, too little accelerator in the replenisher solution may result in decreased densities and contrast due to the decreased activity of the solution.

When replenishment and recirculation procedures are used, your system must include some type of solution filtration device. Dirt particles can enter the system during film entry, solution recirculation, and solution replenishment. These particles must be continually and completely removed. (In addition to dirt particles, chemical residue or even bits of processed material may enter the system and deposit themselves on the surface of the film being processed unless they are filtered out.) Continuous filtration, rather than batch filtration, is generally preferable. There are many types of filters, such as cartridge or bag filters, which may be used.

REPLENISHMENT METHODS.—In most machine processing operations replenishment of developer and fixer is a necessity. It is not economical or practical to use a solution to its exhaustion point and then discard it. Photographic quality is degraded long before the exhaustion point is reached.

In our Navy, photographic quality is maintained with a controlled and monitored replenishment system. Enough is known of how photographic chemicals work and change with use that this is possible. It is possible, through a properly formulated and used replenisher solution, to maintain solutions whose photographic activity varies only negligibly over extended use. Theoretically, there is no limit to the usable life of such a properly replenished solution. In practice, the limitations on length of solution use are often physical or mechanical, such as the need for equipment maintenance, cleaning, etc.

Ideal replenishment involves the continuous replacement of significant chemical components of the developer and other solutions at the same rate at which they are exhausted. Two methods of replenishment are commonly employed. The first is the so called *topping-up* method and is used extensively in closed tank processing. In this method the volume of solution is kept constant by periodic additions of replenisher. Normally, it is possible to maintain a reasonably constant solution activity only for a certain period of replenishment by this method because of the change in the proportion of some of the components in the solution. After a given volume of replenisher has been added, the solution is discarded and the procedure is repeated with fresh solutions.

The second method is one of continuous replenishment, often called a *bleed* system. In this system the replenisher solution being added forces some used developer out through an overflow drain in the solution compartment.

Dryer Temperature

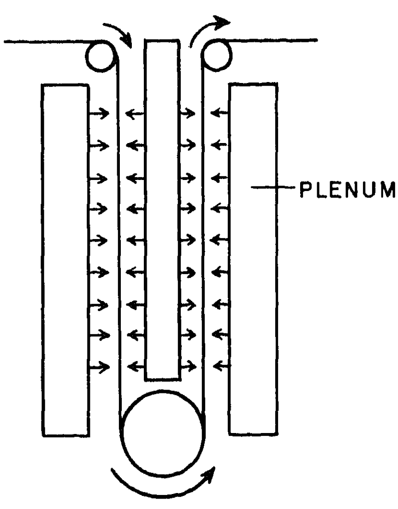
Automatic processing machines normally include a drying cabinet or drying section.

After the material has been developed, fixed, and washed, it continues through the machine into the drying cabinet where the moisture is removed. It emerges dry from the cabinet and is spooled onto a reel, or stacked in the case of sheet film and sheet paper.

The drying cabinet is more than a heated compartment for the processed material. In a majority of machines, both the temperature and the humidity of the cabinet are carefully controlled so that the completely processed material has the desired properties. Too little drying causes the emulsion to be tacky, whereas too much drying may produce excessive curl and brittleness. Both the temperature and the relative humidity of the air supplied to the drying cabinet must be adjusted for the speed at which the machine is operating, and the type of material being dried.

The drying of photographic materials is a complex operation. So that moisture may be removed from all depths of an emulsion, it must first migrate to the surface and then evaporate in the air. The rate at which this takes place depends upon the thickness of the emulsion, the amount of hardening the emulsion received, the density of the developed image, the air temperature, the relative humidity of air, and the movement of the ambient air reaching the film.

Processing machines usually have a heated air impingement-type dryer using high air velocities directed against the surface of the film or paper. In this method, jets of air are applied at right angles to the emulsion and base surfaces of the material simultaneously. An efficient air or roller squeegee must be used since surface liquid remaining on the film or paper produces uneven drying. As with any other type of dryer, the conditions of temperature and velocity must be adjusted to the local climate. Otherwise, the film will dry more rapidly at the edges and you can expect an undesirable curl to result.



Air impingement drying cabinet.

DRYER HUMIDITY AND AIRFLOW.— Under ideal drying conditions, the drying cycle should yield processed material having a stable moisture content in air of about 50-percent relative humidity.

During the drying process, the air is heated to lower its relative humidity, and to accelerate the evaporation of moisture. These two factors are directly proportional to the temperature. The temperature must be held within certain limits. If it is too low, evaporation is slowed down; and if it is too high, the emulsion may be damaged. The exact limits are governed by the kind of material being dried, how it was processed, and the type of dryer being used.

The air must be in continuous motion because air at the surface of the wet emulsion soon becomes saturated and cannot take up additional moisture. Saturation of the air usually results in the material not drying sufficiently. When this happens, most emulsions will feel tacky. Also when warm, dry, air moves too slowly across a paper or film, the material tends to dry more rapidly at the edges than in the center.

Some types of film tend to become excessively brittle when dried rapidly. This "overdrying" is due to excessively low relative humidity. When this occurs, moisture-retaining additives may be introduced into the final rinse, and/or the temperature and relative humidity of the air adjusted to permit slower drying. Brittleness cannot be eliminated once it occurs; and since it cannot be corrected, *it must be prevented.*

Transport Design

Transporting photographic material through a processing machine at any speed involves a helical path arrangement of partially or completely submerged banks of rollers in the various process solutions, wash, and dryer.

The most common system of moving film or paper through a processor is by friction between the rotating rollers or spools and the base side of the material. The other major system is sprocket drive, much the same as is employed in a motion picture camera but without intermittent action.

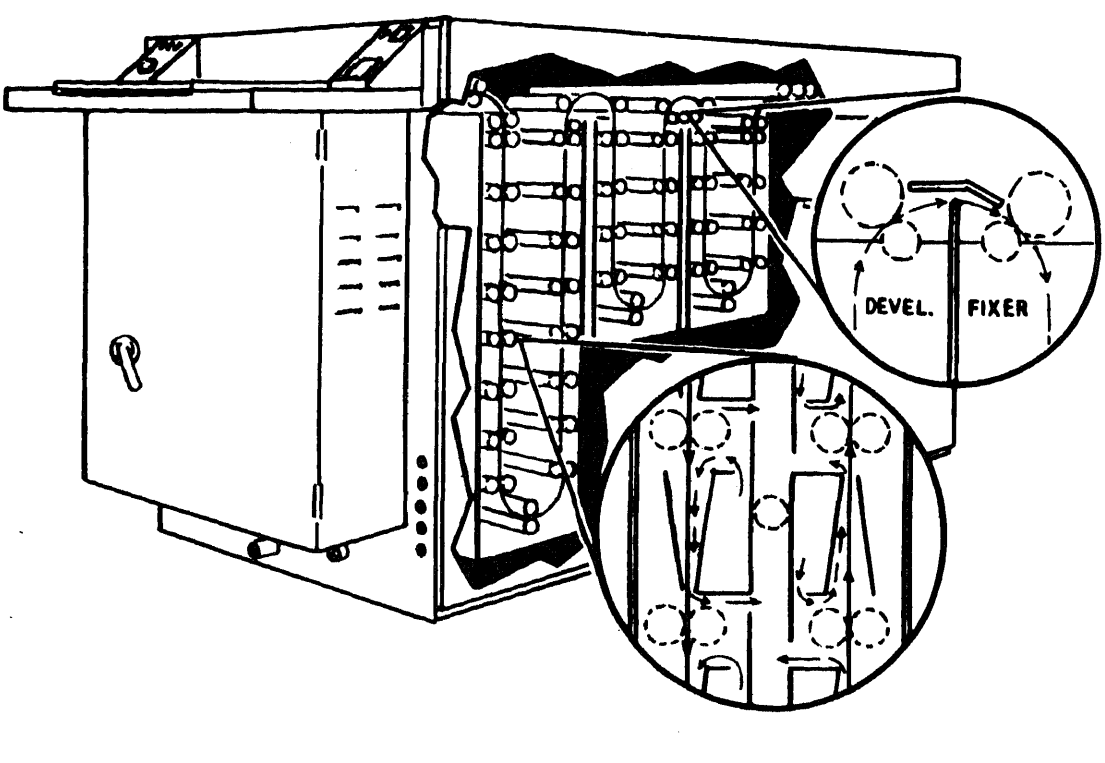
DEFECTS CAUSED BY PROCESSOR MALFUNCTIONS

A number of mechanical or physical, as well as processing errors can result from improper processor operation or monitoring. When operating processing machines, you should inspect the processed material as it leaves the machine and immediately isolate the cause of any defect. As examples, crystallized chemicals on the material can only result from improper washing, and crimpled film or paper edges are produced by undue stress applied on that area of the material. Conditions must be isolated and corrected immediately if acceptable products are to be obtained. Each processor is supplied with a troubleshooting guide to help you identify, isolate, and correct causes of defects.

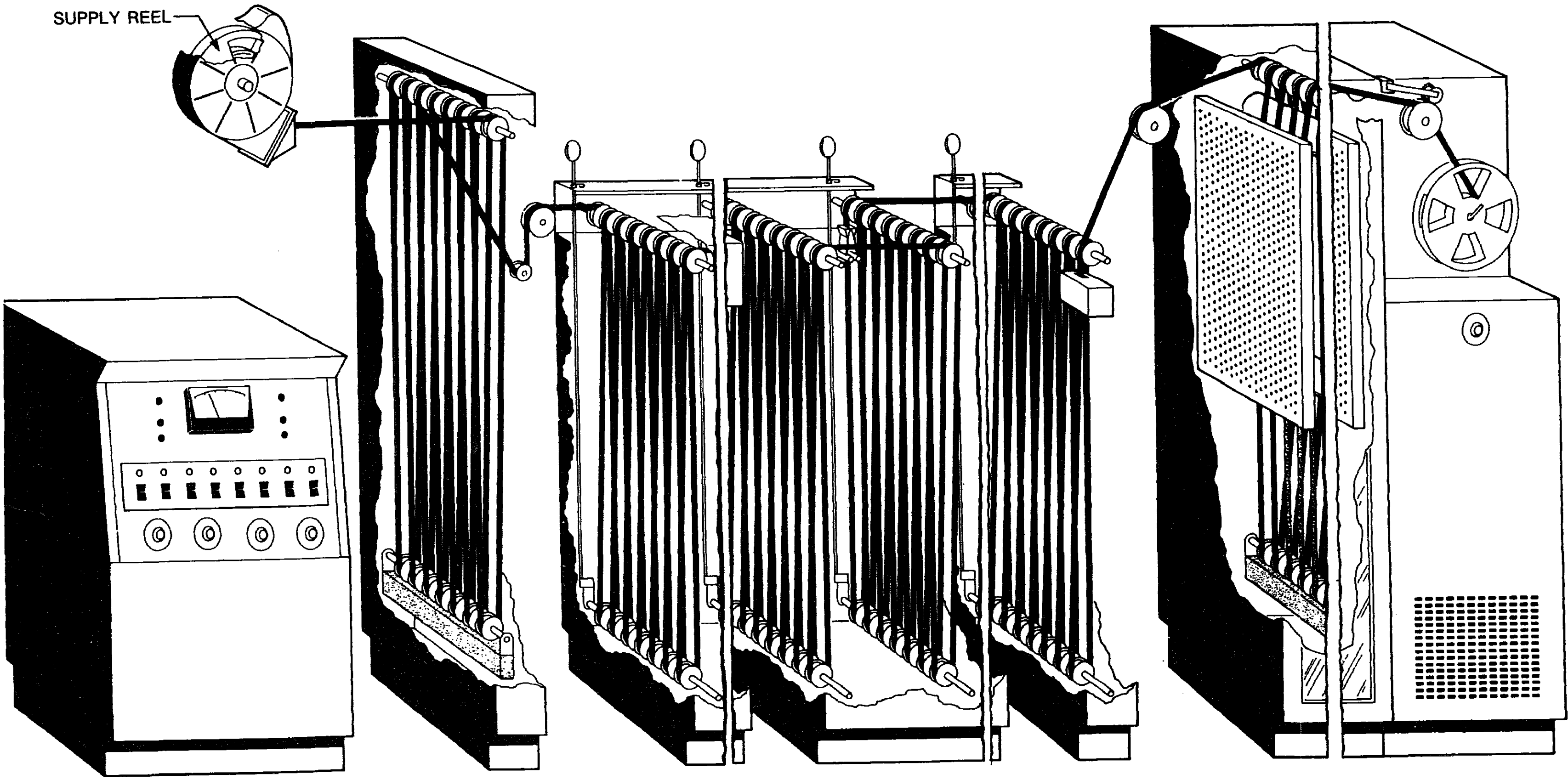
POST-PROCESSING TASKS

When the last roll of film or the last sheet of paper is off the processor your work is still not finished. The processor must be shut down and you must make certain that it will be ready when needed again.

The task of shutting down a processor is an important one. It involves much more than simply turning off switches. The method of shutting down used depends on whether maintenance is to be performed on the machine before it is used again. If it is not, on leadered machines, you begin shutdown by providing sufficient leader to splice onto the trailing end of the film that is being processed. If you automatically thread the processor with leader, the processor is immediately available for the next processing session. Thus, the time consuming process of manually threading the machine is avoided. You do not releader the processor if it is to be stripped



Friction drive film or paper transport.



A cutaway view of a small section of a leadered film processing machine. The leader is attached to the end of the film being processed. Thus the machine is automatically leadered each time film is processed. For subsequent processing runs the film is spliced onto the end of the leader which is in the machine. Imagine the difficulty and time it would take to releader or thread the machine by hand each time film was to be processed.

for cleaning. This requires the removal of all material from the machine and the rethreading of the machine when cleaning has been completed. When leadered machines are not to be deleadered during shutdown, the transport is stopped immediately after the beginning of the rethreading leader appears at the exit of the drying compartment. Replenishment controls should be shut off as soon as processing solutions are no longer being exhausted.

Extended periods of inactivity or solution changes require a complete shutdown. During an extended (complete) shutdown, you should drain the tanks and position all operating switches in their OFF positions. Then wash all of the tanks and transport racks thoroughly and flush all lines. After they have been drained and cleaned, the tanks should be filled with clear water.

CAUTION

Do not overtighten the drain valves. If the machine is idle for long periods with the tanks empty, the valves must be lightly cracked to prevent them from sticking.

If the processor is to be shut down for a short period of time, the dryer heater should be turned off, as should the film transport drive. After the dryer temperature reaches 100 to 110 °F, turn the dryer blower off. In addition to these actions, do the following:

- When applicable, leave the leader threader in the processor and release tension on the last elevator in the wash section.

- Turn off the recirculation pumps.

- Shut off the water to the wash tanks.

The wash water is always turned off *after* the material transport has been stopped. This rids the leader material of all processing chemicals.

For an overnight shutdown, the same procedure used for a temporary (short) shutdown should be followed. In addition, all operating switches should be turned off. The drying compartment blower must remain on as long as the drying compartment is hot enough to damage the heating elements and leader material. Usually, this is the last shutdown task to be performed. While waiting for the dryer temperature to reach acceptable levels, you should perform all other shutdown tasks, including equipment cleaning. The solution temperature control system may be left in operation overnight to maintain solution temperatures.

The shutdown procedures for each processor differ slightly so you must consult the operator and instruction manuals for the particular machine in use. Some manufacturers provide posters showing start-up, shutdown, and periodic maintenance procedures for their machines. It is always a good idea to refer to these posters when performing the various tasks.

Effects of Improper Machine Shutdown

In some cases, the shutdown sequence is important to the life of the processor. In other situations, improperly sequenced shutdown steps could be detrimental to the quality of the material that will be processed in the future. Every time shutdown procedures are improperly conducted, you are taking a chance. This is why it is important for you to know the shutdown procedures and to follow them correctly.

It would be impractical to list all the effects of improper processor shutdown for all the machines. Instead, we emphasize the fact that great damage can be done to any processing system when the dry box blower is turned off before the temperature reaches a safe level. Furthermore, proper shutdown procedures must be conducted or you risk ruining the processing solutions contained within the system.

LABORATORY EQUIPMENT MAINTENANCE

Equipment maintenance can include servicing, repairing, overhauling, reclaiming, modifying, modernizing, converting, rebuilding, inspecting, and testing. In our Navy photo labs and audiovisual facilities, however, we usually think of maintenance as being divided into two broad categories: preventive maintenance and corrective maintenance.

Hope industries

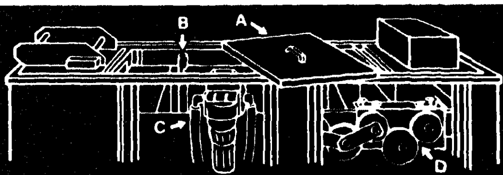
LEADERLESS FILM PROCESSORS

daily start-up

1. CHECK LIQUID LEVEL in REPLENISHER TANKS.
2. CHECK CHEMICAL LEVEL at standpipe overflow. Add water or chemical to bring solution to proper level within chemical manufacturer guide lines, except for E6 bleach. (See "B" below.)
3. CLEAN WASH TANKS with a damp cloth or sponge.
4. Open WATER VALVES and check water temperature.
5. Turn on MAIN DRIVE.
6. Turn on DRYER.
7. Lightly SPRAY all exposed GEARS and rollers with hot water.
8. CHECK for obvious MECHANICAL malfunctions and LEAKS.
9. CHECK solution TEMPERATURES. Make sure solutions are at proper temperature for processing.
10. PROCESS either unused or CLEAN-UP FILM. NOTE: Do not reuse clean-up film.

daily shut-down

1. LIGHTLY SPRAY all exposed GEARS with hot water.
2. Close water MIXING VALVE.
3. Turn off MAIN DRIVE.
4. Drain wash TANKS and replace STANDPIPES.
5. Leave covers ajar. (See "A" below.)



MAINTENANCE SERVICE POINTS
A. Lid
B. Standpipe
C. Filter
D. Lubrication point

periodic maintenance

WEEKLY:

1. CHECK for any signs of LEAKS. If so, tighten clamps, replace if necessary. Check tightness of standpipes.
2. CHECK to make sure all RECIRCULATION pumps are operating properly.
3. CHECK water FILTERS and replace if necessary to ensure proper water flow.
4. CHECK, with a reliable thermometer, chemical and dryer TEMPERATURES.

5a. For the E6 process CHANGE the STABILIZER and remix with distilled water at ½ strength.
5b. For the C41 process DUMP the HARDENER and STABILIZER, clean the rack and tanks and fill with fresh chemistry.
IMPORTANT: Be sure to follow chemical manufacturer's recommendations for proper mixing.

MONTHLY:

1. CHECK MIXING VALVE, water flow and temperature of the mixed water.
2. REMOVE water and chemical FILTERS and replace. Hang filter brackets on top frame when changing. (See "C" below.)
3. CHECK TRANSPORT SYSTEM to assure it turns freely. Clean all racks in running water to remove all deposits and rinse thoroughly.
4. CHECK GEARS, BEARINGS, ROLLERS, and torsion SPRINGS for any signs of wear.
5. CHECK REPLENISHMENT SYSTEM for sensing and rates.
6. WIPE down all INNER SURFACES with a damp sponge.
7. LUBRICATE — A light coating of oil-free lubricant such as CRC-5-56 should be used sparingly on drive train gears. DO NOT USE LUBRICANT ON WET RACKS. (See "D" below.)
8. DUST and CLEAN DRYER RACK, dryer compartment, and air intake filter.

EVERY TWO MONTHS:

1. For the E-6 process, DUMP the REVERSAL and CONDITIONER chemicals, clean the racks and tanks and fill with fresh chemicals. NOTE: In high usage labs, it might be necessary to change on a monthly basis.

Serial No. ____________

Warranty No. ______

For EMERGENCY SERVICE, call ___ ___ ____

To REORDER SOLUTIONS, call ___ ___ ____

HOPE INDUSTRIES, Inc — WILLOW GROVE, PA U.S.A.

Preventive maintenance functions are routine procedures which extend the life and usefulness of our audiovisual equipment. They do this by warning of impending trouble and preventing deterioration, breakdowns, and malfunctions.

Corrective maintenance, as its name implies, is correcting the causes of breakdowns and malfunctions by repairing and replacing defective parts and by similar actions that restore defective or broken equipment.

We discussed camera and associated equipment maintenance in chapter 9 of module 2. In this module we will concern ourselves primarily with laboratory equipment maintenance and repair. Keep in mind, however, that the concepts discussed here can and usually do apply to maintenance and repair of all cameras and associated equipment and audiovisual production equipment.

3-M PROGRAM

In the Navy our equipment maintenance programs are generally operated in accordance with either the *Ships' Maintenance and Material Management (3-M) Manual,* OPNAVINST 4790.4, or the *Naval Aviation Maintenance and Material Management (3-M) Manual,* OPNAV-INST 4790.2.

In the photographic rating we are primarily concerned with the Ships' Maintenance and Material Management (3-M) Program. However, when assigned to an aviation unit, photographic maintenance may be carried out under the Naval Aviation Maintenance and Material Management (3-M) Program, especially where aircraft cameras and associated equipment are concerned.

Because most Navy photographers are not assigned to aviation units, we will discuss the Ships' 3-M Program. As you read the following information on the 3-M Program you may get the impression that it applies to use aboard ships only. This, however, is not necessarily the case. The Ship's 3-M Program concepts and procedures can and probably should be used by all photo labs and audiovisual facilities ashore. In fact, certain shore activities designated by CNO *must* use the Ship's 3-M Program. In other cases, the commanding officer or the audiovisual manager may prescribe use of the Ship's 3-M Program. In these cases, required. However, to take full advantage of the 3-M Program you should consider making the various reports. Not only will making these reports help validate and enhance the Navy's overall 3-M Program but you will be gaining valuable experience that can be put to good use when you are assigned to a ship.

In this chapter we are going to give you a quick overview of the Ships' 3-M Program. Our intent is to make you familiar with the program, not to rewrite the 3-M manual nor to teach you everything there is to know about it. We strongly suggest, however, that after reading this material that you get a copy of both the ships' and aviation 3-M manuals and become familiar with them. And by no means do we suggest that you read the manuals from cover to cover; instead review the chapters and article headings to become familiar with the contents of the manuals so that when the time comes you will be able to find the information you need.

MAINTENANCE AND MATERIAL MANAGEMENT SYSTEMS (3-M)

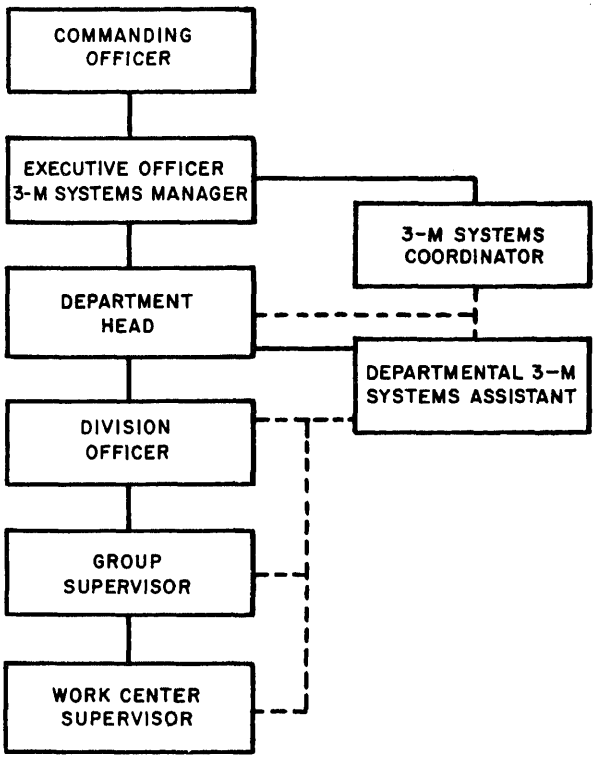
There are two major systems that make up the 3-M System. They are the Planned Maintenance System (PMS) and the Maintenance Data System (MDS). These two systems were developed to provide a means for managing maintenance and maintenance support in a way that will ensure maximum equipment readiness. Their success depends on Navy personnel understanding and meeting their responsibilities under the systems.

3-M Organization and Responsibilities

The 3-M organization starts with the CNO. The higher echelons of the organization are primarily responsible for overall functions, such as developing and implementing policy, providing instructions and direction, and providing data, software, assistance, and training. Personnel from the higher echelons may make periodic inspections to monitor the effectiveness of the systems.

The shipboard or local command 3-M organization is of primary importance to you, since you will probably have the opportunity to

management levels. The responsibilities of each level of 3-M management aboard ship are:



3-M shipboard organization.

● Commanding Officer: The commanding officer has the overall responsibility for ensuring that shipboard maintenance is accomplished in accordance with the 3-M Systems procedures and that the 3-M Systems function effectively within the command.

● Executive Officer: The executive officer, as the ship's 3-M Systems manager, is responsible to the commanding officer for the overall duties of management of the ship's 3-M Systems program. Specifically the 3-M Systems manager's duties include the following actions and responsibilities:

—Being knowledgeable of current Ships' 3-M Systems policies and directives.

—Acting as chairman of periodic 3-M Systems meetings with the department heads and the 3-M Systems coordinator.

—Monitoring the operation of the 3-M Systems program to ensure compliance with current directives.

—Briefing the commanding officer at regular intervals on the status of PMS and MDS documentation.

—Integrating 3-M Systems training into the ship's training program and ensuring that personnel receive adequate and effective 3-M Systems training.

—Acting as approving authority for maintenance responsibility shifts from one division to another.

● 3-M Coordinator: The ship's 3-M Systems coordinator is responsible to the executive officer for the coordination and direct supervision of the administration of the Ships' 3-M Systems program. His duties include:

—Serving as the principal 3-M Systems assistant to the executive officer.

—Ensuring that the ship's 3-M Systems installation is current and distribution of 3-M documentation to work center personnel is timely.

—Advising and assisting department heads, division officers, departmental 3-M Systems assistants, and work center supervisors in matters concerning the 3-M Systems and informing these personnel of changes as they occur.

—Monitoring departmental administration of the 3-M Systems on a continual basis.

—Supervising the functions of the 3-M Systems office.

—Screening MDS documents for legibility and completeness and submitting them to the designated data processing activity.

● Department Head: The department head is responsible for the effective operation of the

3-M Systems within the department. He supervises all cycle and quarterly scheduling of departmental maintenance and other departmental 3-M functions. The department head performs the following duties:

—Regularly inspects the 3-M Systems operation within the department. These inspections include a weekly review of PMS schedules to ensure that they are current.

—Ensures that departmental personnel are properly trained and motivated concerning the 3-M Systems. Their training should include emphasis on the importance of proper PMS scheduling and performance and the necessity for MDS documentation.

—Ensures the currency and proper maintenance of 3-M Systems departmental files and publications, including the Departmental Master PMS Manual and Maintenance Requirement Card (MRC) deck.

—Conducts periodic meetings with division officers and work center supervisors and keeps the executive officer informed of the status of 3-M within the department.

—Provides guidance to division officers and work center supervisors on 3-M matters.

—Signs Cycle and Quarterly Schedules prior to posting and, at the end of each quarter, signs the back of the Quarterly Schedule where the maintenance actions that were not completed during the quarter are listed.

—Ensures appropriate action when equipment is added, deleted, or modified.

—Ensures prompt documentation of all noted material deficiencies on a ship's force work list or the Current Ship's Maintenance Project (CSMP).

—Ensures the submission of all required 3-M Systems documents to the 3-M Systems coordinator.

—Ensures proper distribution, validation, and use of 3-M Systems reports and summaries.

● Departmental 3-M Assistant: The department head assigns an officer or a petty officer, trained and knowledgeable in the 3-M Systems, to provide assistance in the coordination and supervision of all administrative facets of the department's 3-M Systems program.

● Division Officer: The division officer is responsible to the department head and is trained in the 3-M Systems. The division officer assists in managing the maintenance required for the equipment that is the responsibility of the division in the following ways:

—Ensures that qualified senior personnel review Maintenance Index Pages (MIPs) and MRCs to ensure that Maintenance Requirements (MRs) are complete, applicable, and correct.

—Supervises the preparation of the Weekly Schedules to ensure that they are in accordance with the Quarterly Schedule and signs them.

—Spot checks, at least weekly, to ensure that required maintenance is being properly performed as prescribed by MRCs.

—Ensures the weekly updating of the departmental Quarterly Schedule.

—Incorporates 3-M Systems training into the divisional training plan.

—Ensures the completeness, accuracy, and prompt submission of MDS documents generated within the division.

—Works in conjunction with the 3-M Systems coordinator in matters concerning the 3-M Systems.

—Meets with divisional work center supervisors and informs the department head each week of the status of the 3-M Systems within the division.

—Ensures that 3-M Systems division files, publications, MRC decks, Equipment Guide Lists (EGLs), and Tag-Out Guide Lists (TGLs) are complete and current.

● Group Supervisor: Most ships have senior etty officers who are responsible for two or more vork centers. These petty officers are the "group upervisors." Group supervisors are responsible 'or the proper performance of 3-M Systems 'unctions within their respective work centers.

● Work Center Supervisor: The senior petty fficer within the work center is the work center upervisor and is responsible for the effective peration of the 3-M Systems within the work enter. The work center supervisor may not lelegate this responsibility to subordinate naintenance personnel. If you are assigned as the vork center supervisor, you receive 3-M Systems raining and are responsible for the following luties:

—Scheduling weekly work center naintenance operations and supervising their roper accomplishment.

—Ensuring that the status of work center lanned maintenance is correctly reflected on 'MS schedules.

—Ensuring that the division officer or group upervisor is advised of all 3-M Systems activity vithin the work center.

—Maintaining an adequate supply of 3-M naterials within the work center.

—Ensuring prompt documentation of all oted material deficiencies and all completed naintenance actions.

—Ensuring that all 3-M Systems documents ubmitted from the work center are correct, egible, and promptly submitted. Either the work enter supervisor or a designated responsible ndividual who is in training for work center upervisor prepares these documents.

—Ensuring the maximum use of the PMS as n aid in training personnel in maintenance rocedures for the equipment within the work enter.

—Maintaining control and accountability of ob Sequence Numbers (JSNs) within the work enter.

—Verifying that the CSMP (Current Ship's Maintenance Project) is current and complete.

—Reviewing MRCs and promptly submitting a PMS Feedback Report (FBR) whenever maintenance requirements are not fully understood, errors are believed to exist, maintenance requirements appear inadequate or excessive, additional coverage is needed, performance of the maintenance according to the instructions given would cause a hazardous condition to exist, or replacement PMS documents are needed.

—Maintaining an accurate and current List of Effective Pages (LOEP) by comparing the documentation with the actual equipment you have in the work center.

—Ensuring that planned maintenance is accomplished in strict accordance with the MRC.

● Maintenance Personnel: Maintenance personnel are responsible to the work center supervisor. Their 3-M Systems duties include, but are not limited to:

—Reading the Weekly Schedule, to get their maintenance work assignments for the week.

—Performing assigned scheduled maintenance in accordance with the 3-M instructions.

—Informing the work center supervisor of the completion or noncompletion of maintenance work and of any problems encountered in doing it.

—Notifying the work center supervisor about any corrective maintenance that is required or done, so that he may document the maintenance if necessary.

The Planned Maintenance System (PMS)

The purpose of the Planned Maintenance System (PMS) is to allow for the planning, scheduling, and control of equipment maintenance. Although the PMS uses standard procedures, it is flexible enough to be compatible

with operational and other types of schedules. The PMS provides:

- Detailed maintenance procedures.
- Minimum maintenance requirements.
- Scheduling and control of maintenance.
- Descriptions of the methods, materials, tools, and personnel required for maintenance.
- Prevention or early detection of equipment malfunctions.
- Test procedures to determine material readiness.

These are provided in several manuals and documents which we will describe here:

DEPARTMENTAL MASTER PMS MANUAL.—The Departmental Master PMS Manual gives the PMS requirements for the equipment that is the responsibility of the department. The LOEP, or List of Effective Pages, is part of the master manual. The LOEP lists the MIPs, or Maintenance Index Pages, for equipment assigned to a department. Each MIP is a list of the MRCs, or Maintenance Requirements Cards that apply to a system, subsystem, and equipment. For example, all maintenance requirements for the EH-38D are listed on one MIP, the maintenance requirements for the Royalprint Processor are listed on another MIP, and so on until an MIP has been prepared for each type of equipment.

WORK CENTER PMS MANUAL.—The Work Center PMS Manual is a duplicate of that portion of the departmental master manual that contains the planned maintenance requirements applicable to a particular work center. It is used by the work center supervisor as a ready reference.

MAINTENANCE REQUIREMENT CARD (MRC).—The MRC is your best aid for performing planned maintenance on installed equipment.

The MRC contains the following information:

- System, subsystem, and component of the system.
- MRC code. This code consists of two parts. The first part corresponds to the first portion of the MIP identification number; the second part indicates how frequently the maintenance is to be performed (for example, weekly, monthly, or quarterly).
- A brief description of the maintenance to be performed.
- Recommended skill levels of persons qualified to perform the maintenance.
- The average time requirements of the maintenance.
- Safety precautions to be observed.
- Tools, parts, and material necessary to perform the maintenance.
- The detailed procedure for performing the maintenance.
- Physical location of the equipment.
- The date the MRC was prepared.
- An MRC control number, which is unique to each MRC.

> Most MRCs are unclassified; however, if you do have a classified one, it requires the same stowage security as other classified material. The MRC deck should contain a locator card in place of the classified MRC, indicating where the classified card is stowed.

EQUIPMENT GUIDE LIST (EGL).—The EGL is used with an MRC when there are a number of identical items for which the MRC is used. Any equipment listed on an EGL is so indicated in the location block on the MRC.

REPORT NO. PMS 5 NAVAL SEA SUPPORT CENTER ATLANTIC DET (CODE 910) REPORT DATE 07/20/82
PLANNED MAINTENANCE SYSTEM AUTOMATED QFR 3-82
NAVAL AIR FORCES ATLANTIC FLEET LIST OF EFFECTIVE PAGES *(LOEP)* PAGE 1 708

UNIT-- CV 0066 UIC-- 003366 WORK CENTER-- OP01 USS AMERICA

LINE ITEM	MIP	NOMENCLATURE	CID/APL/TM	QTY	EQUIP STAT	ADDS/ CHNGS
0010	PH - 003/001-A1	STILL PIX CAMR KG-26A				
0020	PH - 003/002-A1	MOTION PIX CAMERA B&H 70MDL				
0030	PH - 003/005-78	STILL PIX CAMERA KE-64A/64B				
0040	PH - 003/006-A1	STILL PIX CAMERA-POLAROID				
0050	PH - 003/008-A1	STILL PIX CAMERA KE-60A				
0060	PH - 003/009-78	STILL PIX CAMERA-GRAPHIC				
0070	PH - 003/010-71	STILL PIX CAMERA KS-117A				
0080	PH - 003/013-10	STILL PIX CAMERA (KE-46A)				
0090	PH - 004/001-A1	PHOTOGRPH CONT PTR (EN-80A)				
0100	PH - 004/004-72	PROJECTION PRINTER EN-52				
0110	PH - 004/008-A1	PHOTO PJTN PTR EN-124A D-3				
0120	PH - 005/001-12	PHOTO PRCS SINK FM112A/113A				
0130	PH - 005/002-A1	MIXING TANK FM-152A				
0140	PH - 005/003-A0	PHOTOGRPH PRINT WASH EK-6A				
0150	PH - 005/008-72	PHOTOGRPH CLR ANALZR FM-197				
0160	PH - 005/015-A1	PHOTO PRINT DRIER				
0170	PH - 005/016-A1	PHOTO FILM DRIER SENRAC				
0180	PH - 005/023-A1	DRY MOUNTING PRESS FM-207A				
0190	PH - 005/027-72	PHOTO PAPER PROC MACH CPT16			EGL	
0200	PH - 005/029-A2	PHOTGPH PAPER PROC MAC KODK				
0210	PH - 005/030-A1	PHOTO SLIDE MNTG MACH 620				
0220	PH - 005/034-A1	PHOTO FILM-PAPER PRCS MAC				

-- EGL - DENOTES EQUIPMENTS WITH WHICH GUIDE LISTS ARE COMMONLY USED

List of Effective Pages (LOEP).

PMS SCHEDULES.—There are three schedules used in the PMS. They are the Cycle, Quarterly, and Weekly Schedules. Each is a visual display of planned maintenance requirements to be performed.

The Cycle Schedule schedules maintenance to be performed in the period between major overhauls of the ship. The Cycle Schedule is used to plan and schedule maintenance requirements each calendar quarter. Proper preparation of the Cycle Schedule directly affects long range PMS scheduling.

The Quarterly Schedule displays the work center PMS requirements that are to be performed during a specific 3-month period. It is a guide for the work center supervisor in scheduling weekly maintenance. The Quarterly Schedule is updated weekly, by marking off the maintenance tasks performed during the week. When properly maintained it shows what maintenance actions were scheduled for each week of the quarter, which were completed, and which were not completed or were rescheduled to another week. If any monthly, quarterly, semiannual or annual maintenance actions remained uncompleted during three allowable intervals, this fact and the reason for the noncompletion are noted on the back of the schedule. Those actions that were not completed and have not exceeded the allowable interval may be rescheduled into the next quarter and noted on the front of the schedule. Each Quarterly Schedule, when completed, is normally retained for 1 year as a record.

The Weekly Schedule is made from the Quarterly Schedule and posted in the work center. It displays the maintenance to be performed in a given week and those scheduled during the next four weeks. Maintenance tasks that are done every week are permanently displayed on the schedule. Less frequently performed tasks are added from the quarterly schedule on the week they are due to be done. On this schedule you assign the maintenance requirements to be done by each of your people. At the end of the week, you use the Weekly Schedule to update the Quarterly Schedule. The division officer reviews the Weekly Schedules for accuracy and completeness.

FEEDBACK REPORT (FBR).—Feedback Reports are forms used to notify NAVSEA-CENLANT/PAC, NAVSEACEN, or type

SYSTEM, SUBSYSTEM, OR EQUIPMENT	REFERENCE PUBLICATIONS	DATE
Sound Motion Picture Projectors AQ-2(4), AQ-3(7), AQ-2(1) (B & H) (Viewlex)	NAVSHIPS 0810-043-9500 Technical Manual for Sound Motion Picture Projectors Types AQ-2(4), AQ-3(7) and AQ-2(1)	April 1979

CONFIGURATION:

[illegible]	[illegible]	SYSCOM MRC CONTROL NO.	MAINTENANCE REQUIREMENT	PERIODICITY CODE	SKILL LEVEL	MAN HOURS	RELATED MAINTENANCE
			Scheduling aids: 1. Review MRC M-1. Omit requirement if equipment is hardwired to ship electrical system; no feedback report required. 2. DDEOC ships that have completed a Baseline Overhaul and entered an extended operating cycle are not to schedule R-3 as a planned requirement. The action is handled automatically by the DDEOC Program. ****For scheduling purposes only; no MRC is provided.**				
		49 HAJL N	1. Inspect power cord.	M-1	EM/IC3	0.1	None
		49 HAJY N	1. Inspect exciter lamp. **NOTE:** Accomplish monthly or after 50 hours of operation, whichever occurs first.	M-2R	EM/IC3	0.1	None
		78 HAJZ N	1. Inspect and clean film sprockets, film sprocket shoes, and film rollers. **NOTE:** Accomplish quarterly or after 100 hours of operation, whichever occurs first.	Q-1R	EM/IC3	0.2	R-2
		78 HAKA N	1. Inspect and clean inner glass surfaces of condensing lenses. **NOTE:** Accomplish quarterly or after 100 hours of operation, whichever occurs first.	Q-2R	EM/IC3	0.2	R-1
		78 HAKB N	1. Inspect and clean take-up and rewind pulleys. **NOTE:** Accomplish semiannually or after 300 hours of operation, whichever occurs first.	S-1R	EM/IC3	0.1	None
		78 HAKC N	1. Inspect film sprockets, sprocket shoes, film sprocket strippers, film guide adjustment roller, and film rollers. **NOTE:** Accomplish annually or after 500 hours of operation, whichever occurs first.	A-1R	EM/IC3	0.2	Q-1R
		78 HAKD N	1. Inspect and clean projection lens, condensing lens, projection lamp reflector, and sound optical unit. **NOTE:** Accomplish after each use.	R-1	EM/IC3	0.1	R-2
		78 HAKE N	1. Inspect and clean sound drum, pressure plate, aperture plate, film sprocket shoes, film sprockets, and take-up and rewind belts. **NOTE:** Accomplish after each use.	R-2	EM/IC3	0.2	R-1
			1. Schedule projector for lubrication and intermediate maintenance at an authorized repair activity. **NOTE:** Accomplish after 1000 hours of operation or every 2 years, whichever occurs first.	R-3 **			

SHIP SYSTEM	SUBSYSTEM	MRC CODE	
		PH-5 M-1	
SYSTEM	**EQUIPMENT**	**RATES**	**M/H**
	Photographic Paper Processing Machine (Kodak Royalprint Processor) Model 417	PHAN	0.4

MAINTENANCE REQUIREMENT DESCRIPTION

1. Test temperature of fixer solution and drier.

TOTAL M/H 0.4

ELAPSED TIME 0.4

SAFETY PRECAUTIONS

1. Forces afloat comply with Navy Safety Precautions for Forces Afloat, OPNAVINST 5100 series.

TOOLS, PARTS, MATERIALS, TEST EQUIPMENT

TOOLS

1. Thermometer (furnished with processor)

PROCEDURE

1. **Test Temperature of Fixer Solution and Drier.**
   a. Turn processor on and let warm to processing temperature. Ready light will blink on and off when ready.
   b. Turn processor off.
   c. Remove activator bottle, top cover, drier cover, and drier rack assembly.
   d. Unplug and remove fan plate assembly.
   e. Remove fixer rack.
   f. Insert thermometer between the fixer fountains at left side of processor so that stem is in the opening of the sump cover and head is resting on top of fountains.
   g. Test fixer temperature as follows:
      (1) Allow thermometer enough time to reach maximum reading.
      (2) Temperature should read $110 \pm 3°F$ ($43.3 \pm 1.7°C$).
      (3) If reading is outside this range, notify a qualified technician for adjustment.
   h. Remove and rinse thermometer.
   i. Reinstall fixer rack.
   j. Reinstall fan plate and drier rack assembly.
   k. Reinstall top cover and replace activator bottle.
   l. Lift front of drier rack and insert thermometer between manifold and spacer duct. Keep stem of thermometer halfway between sides of manifold with end of stem under center air tube of manifold.
   m. Lower drier rack until manifold rests on thermometer stem.
   n. Turn processor on.
   o. Test drier temperature as follows:
      (1) Allow thermometer enough time to reach maximum reading.
      (2) Temperature should read 155 to 160°F (68 to 71°C).
      (3) If readings are outside this range notify a qualified technician for adjustment.

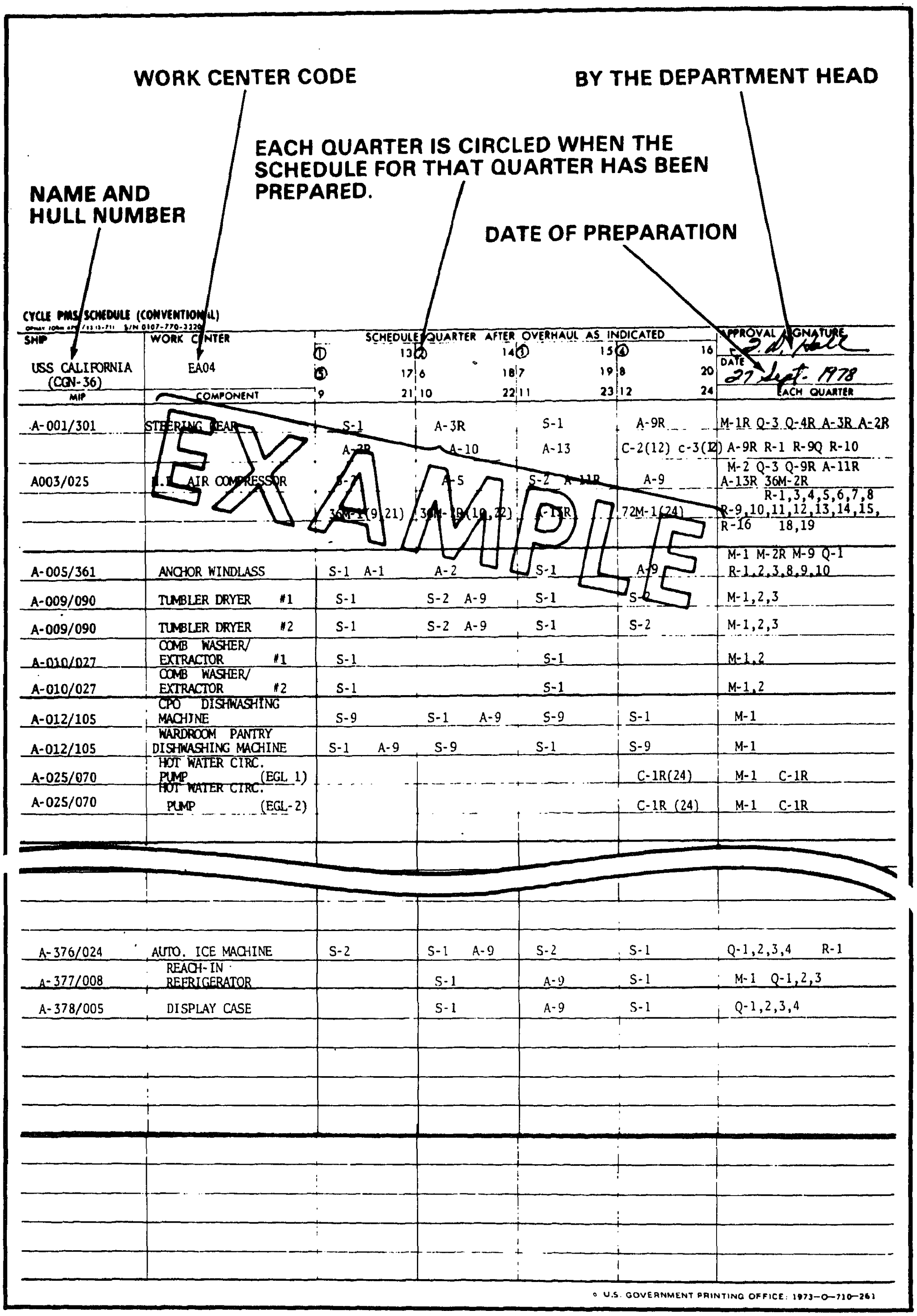
PAGE 1 OF 2

12 HAUA N

LOCATION	DATE
Equipment Guide List Recommended	January 1982

MAINTENANCE REQUIREMENT CARD (MRC)
1 IND NAVSEACENPAC 4700 1 (9 75)

Maintenance Requirement Card (MRC).



CYCLE PMS SCHEDULE (CONVENTIONAL)

OPNAV FORM 4790/13 S/N 0107-770-3220

SHIP: USS CALIFORNIA (CGN-36) — WORK CENTER: EA04 — APPROVAL SIGNATURE: [illegible] — DATE: 27 Sept. 1978

SCHEDULE QUARTER AFTER OVERHAUL AS INDICATED

MIP	COMPONENT	1 – 13 / 5 – 17 / 9 – 21	2 – 14 / 6 – 18 / 10 – 22	3 – 15 / 7 – 19 / 11 – 23	4 – 16 / 8 – 20 / 12 – 24	EACH QUARTER
A-001/301	STEERING GEAR	S-1	A-3R	S-1	A-9R	M-1R Q-3 Q-4R A-3R A-2R
		A-3R	A-10	A-13	C-2(12) C-3(12)	A-9R R-1 R-9Q R-10
A003/025	L.P. AIR COMPRESSOR	S-[illegible]	A-5	S-2 A-11R	A-9	M-2 Q-3 Q-9R A-11R A-13R 36M-2R R-1,3,4,5,6,7,8
		36M-1(9,21)	36M-1R(10,22)	A-13R	72M-1(24)	R-9,10,11,12,13,14,15, R-16 18,19
A-005/361	ANCHOR WINDLASS	S-1 A-1	A-2	S-1	A-9	M-1 M-2R M-9 Q-1 R-1,2,3,8,9,10
A-009/090	TUMBLER DRYER #1	S-1	S-2 A-9	S-1	S-2	M-1,2,3
A-009/090	TUMBLER DRYER #2	S-1	S-2 A-9	S-1	S-2	M-1,2,3
A-010/027	COMB WASHER/ EXTRACTOR #1	S-1		S-1		M-1,2
A-010/027	COMB WASHER/ EXTRACTOR #2	S-1		S-1		M-1,2
A-012/105	CPO DISHWASHING MACHINE	S-9	S-1 A-9	S-9	S-1	M-1
A-012/105	WARDROOM PANTRY DISHWASHING MACHINE	S-1 A-9	S-9	S-1	S-9	M-1
A-025/070	HOT WATER CIRC. PUMP (EGL 1)				C-1R(24)	M-1 C-1R
A-025/070	HOT WATER CIRC. PUMP (EGL-2)				C-1R (24)	M-1 C-1R
A-376/024	AUTO. ICE MACHINE	S-2	S-1 A-9	S-2	S-1	Q-1,2,3,4 R-1
A-377/008	REACH-IN REFRIGERATOR		S-1	A-9	S-1	M-1 Q-1,2,3
A-378/005	DISPLAY CASE		S-1	A-9	S-1	Q-1,2,3,4

U.S. GOVERNMENT PRINTING OFFICE: 1973—O—710—261

Cycle Schedule.

QUARTERLY PMS SCHEDULE (CONVENTIONAL)

WORK CENTER EA04 | YEAR 78 | QUARTER AFTER OVERHAUL 3rd | APPROVAL SIGNATURE [signature] | DATE 27 Sept 78

MONTH October | MONTH November | MONTH December

MIP	30			21	28	4		18	25	2		16	23	RESCHEDULE
A-001/301-36	~~M-1R~~			Q-3 Q-4R	S-1 A-2R	M-1R				M-1R				
A-003/025-58	M-2 ~~M-2~~			Q-3		M-2	Q-9R				M-2			
A-005/361-77	~~M-1~~ ~~M-1R~~ M-9	M-9		Q-1	A-1	M-1 M-2R M-9 S-1				M-9	M-1 M-2R			
A-009/090-37		M-3 M-1 M-2					M-1 M-2 M-3	S-1		M-1 M-2 M-3				
A-009/090-37	~~M-1~~ ~~M-1~~		S-1			M-1 M-2 M-3					M-1 M-2 M-3			
A-010/027-93		M-1 M-2	S-1				M-1 M-2			M-1 M-2				
A-010/027-93		M-1 M-2	S-1				M-1 M-2			M-1 M-2				
A-012/105-65	~~M-1~~			S-9		M-1				M-1				
A-012/105-65	~~M-1~~				S-1 A-9	M-1				M-1				
A-025/070-23		M-1					M-1				M-1			
A-025/070-23		M-1					M-1				M-1			
A-376/024-28								Q-1 Q-2	S-2 Q-3 Q-4					
A-377/008-18	~~M-1~~		Q-1 Q-2 Q-3			M-1					M-1			
A-378/005-C4			Q-1 Q-2 Q-3 Q-4											

UPDATE THIS SCHEDULE EVERY WEEK

Quarterly Schedule.

WEEKLY PMS SCHEDULE (CONVENTIONAL)
OPNAV FORM 4790/15 (3-71)
S/N 0107-LF-770-3280

*U.S. GPO: 1978 - 700-134

WORK CENTER: EA04

PMS SCHEDULE FOR WEEK OF: 7-14 OCTOBER

APPROVAL SIGNATURE: C. Jarrell

MIP	COMPONENT	MAINTENANCE RESPONSIBILITY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SAT.-SUN.	OUTSTANDING REPAIRS AND P.M. CHECKS DUE IN NEXT 4 WEEKS
A-001/301	STEERING GEAR	BACHMAN	D-3R W-1R	D-3R	D-3R	D-3R	D-3R	D-3R D-3R	[illegible] D-3R W-1R W-2R W-3R M-1R
		BACHMAN	W-8 W-2R W-3R						Q-4R A-2R A-3R A-9R R-1 R-90 R-10
A-003/025	HP AIR COMPRESSOR	CAPAZZI	W-3						[illegible] M-2 Q-9R A-11R A-13R 36M-2R
		CAPAZZI							R-1 R-2W R-3 R-4 R-5 R-6 R-7 R-8 R-9 R-10 R-11
		CAPAZZI							R-12 R-13 R-14 R-15 R-16 R-18 R-19
A-005/361	ANCHOR WINDLASS	CHRISTY	W-1 W-2 W-8		M-9				[illegible] R-9 R-10 M-2R R-1 R-2 R-3 R-8
A-009/090	TUMBLER DRYER #1	FLANAGAN		M-1	M-2 M-3				
A-009/090	TUMBLER DRYER #2	FLANAGAN							S-1 M-1 M-2 M-3
A-010/027	COMB. WASH/ EXTRACTOR #1	BACHMAN	W-1 W-2 W-4	M-1 M-2					S-1
A-010/027	COMB. WASH/ EXTRACTOR #2	BACHMAN	W-1 W-2 W-4		M-1 M-2				S-1
A-012/105	CPO DISHWASHING MACHINE	BARNES	W-1						S-9 M-1
A-012/105	WARDROOM PANTRY DISH MACHINE	FRERICHS	W-1						S-1 A-9 M-1
A-025/070	HOT WATER CIRC. PUMP (EGL-1)	ROGERS				M-1			C-1R
A-025/070	HOT WATER CIRC. PUMP (EGL-2)	ROGERS		M-1					C-1R
A-376/024	AUTOMATIC ICE MACHINE	CAPAZZI							R-1
A-377/008	REACH-IN REFRIGERATOR	CHRISTY							Q-1 Q-2 Q-3 M-1
A-378/005	DISPLAY CASE	CHRISTY	W-1						Q-1 Q-2 Q-3 Q-1

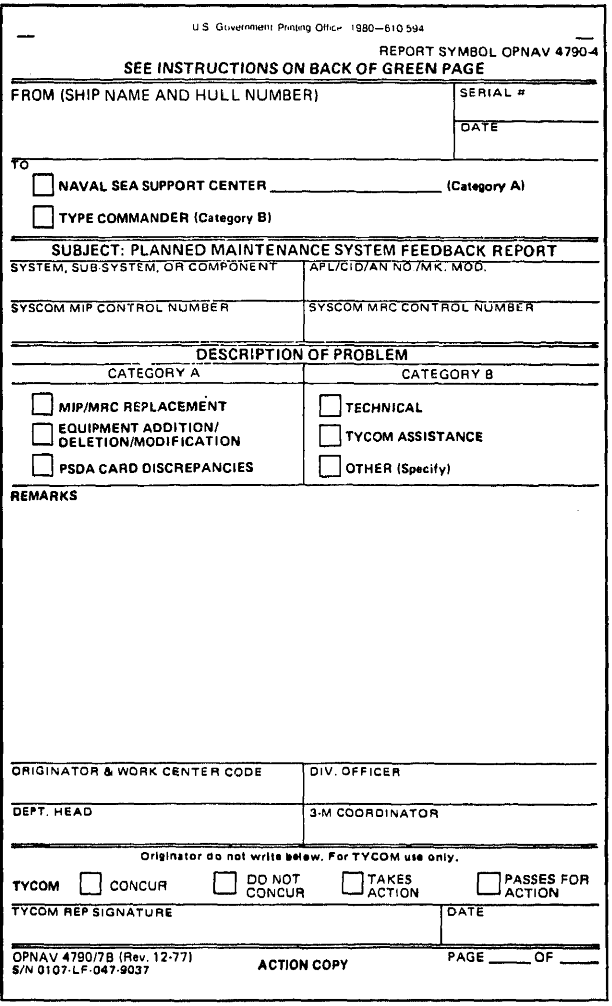
UPDATE THIS SCHEDULE DAILY

Weekly Schedule.

commanders (TYCOMs) of PMS-related matters. There are two categories of FBRs. Category A is nontechnical. It is used for administrative things such as ordering replacement MIPs and MRCs and reporting discrepancies in LOEPs. Category B is used to report technical discrepanceis that can be in documentation, equipment design, safety procedures, or deficiencies in PMS support.

PMS Management

Each type commander maintains a team of



U S Government Printing Office 1980—610 594

REPORT SYMBOL OPNAV 4790-4

SEE INSTRUCTIONS ON BACK OF GREEN PAGE

FROM (SHIP NAME AND HULL NUMBER) | SERIAL # | DATE

TO

☐ NAVAL SEA SUPPORT CENTER ______________ (Category A)

☐ TYPE COMMANDER (Category B)

SUBJECT: PLANNED MAINTENANCE SYSTEM FEEDBACK REPORT

SYSTEM, SUB-SYSTEM, OR COMPONENT | APL/CID/AN NO./MK. MOD.

SYSCOM MIP CONTROL NUMBER | SYSCOM MRC CONTROL NUMBER

DESCRIPTION OF PROBLEM

CATEGORY A	CATEGORY B
☐ MIP/MRC REPLACEMENT	☐ TECHNICAL
☐ EQUIPMENT ADDITION/ DELETION/MODIFICATION	☐ TYCOM ASSISTANCE
☐ PSDA CARD DISCREPANCIES	☐ OTHER (Specify)

REMARKS

ORIGINATOR & WORK CENTER CODE | DIV. OFFICER

DEPT. HEAD | 3-M COORDINATOR

Originator do not write below. For TYCOM use only.

TYCOM ☐ CONCUR ☐ DO NOT CONCUR ☐ TAKES ACTION ☐ PASSES FOR ACTION

TYCOM REP SIGNATURE | DATE

OPNAV 4790/7B (Rev. 12-77) S/N 0107-LF-047-9037 ACTION COPY PAGE ____ OF ____

Feedback Report (FBR).

This team is responsible for monitoring PMS installations, providing assistance when needed, and periodically inspecting and evaluating the PMS installations.

PMS SAFETY PRECAUTIONS.—The necessity of making all our photographers safety conscious cannot be overstressed. Accidents do not respect persons or rights. Statistics show that a high percentage of accidents or casualties could have been prevented if some specific precautionary measures had been taken.

Every effort has been made to indicate hazards to personnel in the "Safety Precautions" block

interest of safety, it is vital that when you are maintaining and operating photographic equipment that you are properly indoctrinated and trained and that you be alert and use common sense at all times.

Inadequacies in the MRC that could affect the safety of personnel or equipment should be reported on an urgent PMS FBR.

EVALUATION OF PMS PERFORMANCE.—In order to have an effective maintenance program, all levels of management, from the work center supervisor through the commanding officer, must be fully involved in and responsible for PMS performance. In this regard, you must keep top level management informed about the material condition of your equipment and also the extent to which PMS is being accomplished. Your command should observe the following guidelines in evaluating the effectiveness of its PMS:

- Determine, by questioning and observing, the degree of supervision and attention given to the PMS. In too many cases, PMS scheduling, deferrals, and rescheduling are left to lower rated personnel without adequate supervision and guidance. Officers and senior petty officers should know the condition of the equipment for which they are responsible, including the status of the PMS.

- Observe and inquire into PMS supervisory and quality assurance practices. Qualified personnel should make sure that work is properly performed as described and specified on the MRCs. Simple maintenance requirements need spot checks while more complex ones require verification when performed.

- If you note a PMS document deficiency, submit a PMS Feedback Report.

- It is the command's responsibility to ensure that EGLs include the equipment aboard the ship or station. A review of your work center MRC deck can show whether this requirement is met.

Spot Checks.—Individual maintenance requirements should be spot checked periodically to determine the effectiveness of accomplishment. The following are the *minimum* number and frequency of checks recommended.

Management Level	Number of MRs Audited	Interval
Commanding Officer/ Executive Officer	1 per own ship	Weekly
Department Head	3 per own department	Weekly
Division Officer	1 per own division work centers	Weekly

Maintenance Data System (MDS)

The Maintenance Data System collects and provides information about maintenance and maintenance support actions for use by various levels and areas of management throughout the Navy.

The objectives of the MDS are:

- Providing CSMP reports, which show what maintenance or repairs are currently being undertaken or are awaiting action.

- Producing automated work requests to obtain assistance from tenders, shipyards, or other repair facilities.

- Producing deficiency documents for use by the Board of Inspection and Survey (INSURV).

- Providing effective management and control of maintenance workloads.

- Reporting configuration changes.

- Keeping Navy managers informed of expenditures.

- Producing an input to the Ship's Force Overhaul Management System (SFOMS).

- Supplying information necessary to improve the reliability and maintainability of installed equipments. The system tends to put badly designed or unreliable equipment "on report."

- Maintaining a history of maintenance information.

You will use the MDS to report maintenance actions. The effectiveness of the MDS depends upon the accuracy, completeness, and timeliness of the reports filled out. Thus, it is extremely important for you to screen all documentation filled out by maintenance personnel.

There are two types of maintenance actions—deferred and completed. Deferred maintenance actions are those that require outside assistance, cannot be completed within 30 days, or are INSURV discrepancies. Completed maintenance actions are submitted when a deferred maintenance is completed, the ship's or unit's personnel complete the maintenance within 30 days, or when a configuration change occurs.

FAILED PART REPORTING.—Failed part reporting identifies those parts which failed and caused their associated equipment to be laid up for repairs. Ideally, only one item in a given failure incident is the primary cause of the failure and, therefore, should be the only failed part reported, even though it may have caused several secondary failures. It is not always possible to determine which part caused the failure. In this case, all parts suspected of being the primary cause should be reported as "Failed Parts." A worn but serviceable part which is replaced to ensure continued reliable operation of an equipment is not a "Failed Part" as long as the equipment operates at its design specification. The reporting of "Failed Parts" requires sound judgment on your part to prevent a flood of meaningless failed parts data from entering the data bank.

When, in your judgment, a part is actually a "Failed Part," the letters "FPR" are entered in the last three positions of the EIC block of the NAVSUP Form 1250 or the "remarks" section of the DD Form 1348 used to order the replacement part. The entry of "FPR" allows computer processing to extract data for engineering analysis.

MDS FORMS.—Complete details on the procedures for filling out and submitting MDS documentation can be found in Volume 2 of OPNAVINST 4790.4.

3-M SYSTEMS TRAINING

All Navy photographers should be trained in the 3-M Systems. You must understand why the PMS is essential to sustained material readiness; how the 3-M Systems maintenance information you document is used to construct automated CSMPs, work requests for outside assistance, deficiency lists for INSURV, and histories of past maintenance actions; and how and why managers at the systems command level are dependent upon 3-M Systems information to identify and correct equipment problems. To this end, the Chief of Naval Education and Training (CNET) is responsible for maintaining a 3-M Systems training plan designed to meet the needs of the fleet.

Formal 3-M Training

Formal 3-M Systems training is provided in the curricula of Class "A" schools. Formal 3-M training is also available upon request at various fleet training activities.

Informal 3-M Training

The ship's (or unit's) own 3-M Systems training plan, must be developed and aggressively pursued. The 3-M Systems coordinator must take an active part in the creation, updating, and execution of the ship's 3-M Systems training program. Personnel should be motivated to comply with the PMS, and understand the need for accurate documentation of work accomplished or deferred, and know how to use the management tools of the 3-M Systems; for example, PMS schedules, MRCs, FBRs, CSMP, and automated work requests.

Individual on the job training (OJT) conducted by petty officers must be part of the maintenance effort. An experienced maintenance person or senior petty officer should accompany the trainee and demonstrate the use of the MRC. The procedures, tools required, safety precautions, and other pertinent details, should be explained as maintenance is performed. The person receiving instruction should not be allowed to perform the required maintenance unsupervised without the approval of the work center supervisor.

TYCOM Assist Visits

TYCOM 3-M Systems teams are available to provide instruction to personnel within their type commands either upon request or during scheduled visits.

TROUBLESHOOTING

We will touch lightly on troubleshooting. Because the first part of the chapter dealt with processing machines, we will use processors in some of our examples of troubleshooting procedures and techniques. Keep in mind, however, that the concepts described here apply equally well to other equipment.

TROUBLESHOOTING EQUIPMENT

To function correctly and efficiently, equipment must be properly cared for and maintained. If maintenance is performed consistently and in accordance with approved procedures, little trouble should be experienced. On equipment there may be many adjustments which must be performed. You will find that most of these adjustments are not difficult, particularly if you follow the detailed instructions contained in the operating and maintenance instructions supplied by manufacturers.

Detecting Malfunctions

Troubleshooting a continuous processor, for example, is a function which evaluates the performance of the processor in terms of operation and product quality. Every function on each system must operate the way it should. If it does not operate as designed, some signs will be evident. The most common signs are detected by:

- *Hearing.* This sense is used to detect any malfunction that produces unusual sounds. Noisy

malfunctions might include, the improper meshing of gears, worn or improperly lubricated bearings, and loose or improperly lubricated drive chains.

- *Slight.* At times, malfunctions are indicated by motions and indicators long before they affect product quality or stimulate a sense other than the eye. These malfunctions include such things as those displayed on the processor control indicators (temperature, replenishment rates, and speeds) and by indicator lights, other signs of trouble might include movements such as a rising lift rod or even the presence of smoke. Furthermore, some malfunctions can only be detected by a visual examination of the finished product. These include scratches, developing streaks, drying streaks, etc.

- *Touch.* At times, conditions might be such that the sense of touch is the best way to detect malfunctions. This is especially true when total darkness is required to prevent material loss, and moving equipment parts are enclosed in some type of housing. Usually, defective bearings or bushings, or the need for lubrication of these parts which are concealed by a housing can best be detected by feeling for a buildup of heat or unusual vibrations.

USING TROUBLESHOOTING TABLES.— Troubleshooting a processor or other equipment is not a difficult task. The manufacturer will usually identify the most common operating malfunctions, their probable cause or causes, and the procedure for correcting the malfunction. These are often produced in table form.

Most troubleshooting tables are arranged in columns that list the trouble, give the probable cause(s), and suggest one or more remedies. Once the trouble is identified, you refer to the table to determine the probable cause and then make the necessary repairs or adjustments to correct the malfunction.

Another type of troubleshooting table is the logic flow diagram. In a logic flow diagram you simply "enter" the diagram and follow the arrows to various blocks or segments and perform the functions indicated and/or move on to the next segment in a prearranged logical manner. A logic flow diagram is usually accompanied by other diagrams and troubleshooting or maintenance instructions.

Reasons for Troubleshooting

Every piece of audiovisual production equipment was designed to do a particular job in a specific way. Furthermore, this equipment was obtained by the Navy because it needed the product that could be produced by that particular piece of equipment. In other words, the type of product, the speed at which the product can be produced, and the desired product characteristics are the factors which are considered before our Navy equipment is purchased. For these reasons, it is only common sense that each printer, processor, etc., must be maintained in such a way that it will function as it was designed to.

As equipment is used, its parts slowly wear out even with complete and competent maintenance. As this deterioration occurs, more variation occurs in functioning systems, (as an example, the evenness of the air from one side of an air squeegee to the other). Add to this the fact that the larger, complex, and older the equipment, the higher the probability that a system will malfunction.

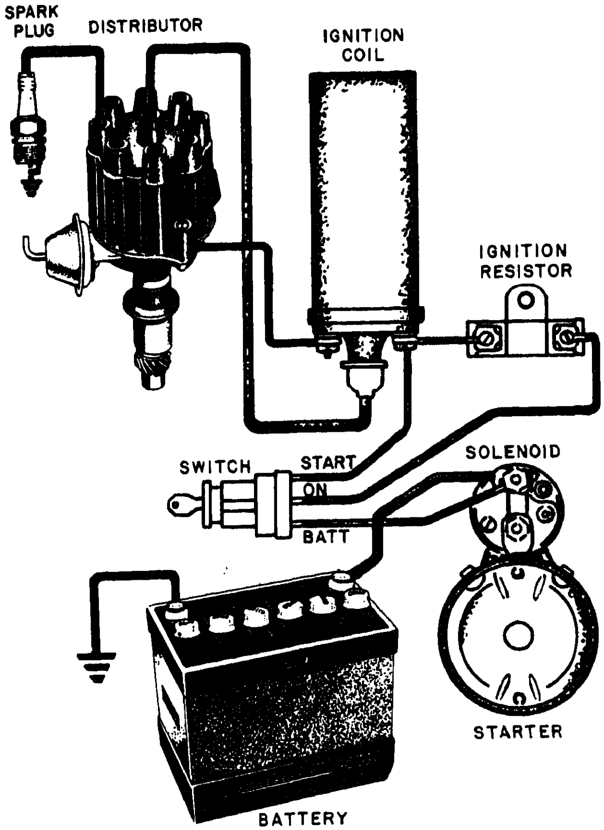
ELECTRICAL DIAGRAMS

A vast majority of the laboratory equipment used by today's Navy photographers is operated by electricity. In order for you to adequately troubleshoot and perform maintenance on this equipment you should have a basic knowledge of electricity and electrical diagrams. If you haven't been trained in electricity, we suggest you acquire and read the *Navy Electricity and Electronics Training Series* (NEETS Modules), especially Modules 2, 3, and 4. If you already know something about reading diagrams, we present here a review to help you "get up to speed." If you understand electrical diagrams and can follow prescribed maintenance and troubleshooting procedures and can use a voltmeter you should be able to analyze and locate most faulty electrical components of audiovisual equipment.

When working with electricity, sailors commonly refer to *all* electrical diagrams as "schematics." This, however, is not correct. A schematic is a specific type of diagram with

TROUBLE	PROBABLE CAUSE	REMEDY
Motors do not run	Failure of power supply	Check supply source outlet.
	Faulty "START" button.	Replace "START-STOP" unit.
Pump and drive motor	Fuse burned out indicating short in motor or wiring.	Repair wiring or replace motor.
Drying cabinet blower motor.	Fuse burned out indicating short in wiring or short circuited blower motor.	Repair wiring or replace motor.
Loading elevator	Film catches in magazine. Elevator rollers stick.	Remove rollers, wash in trichloroethylene or solvent. Federal Specification P-S-661 and lubricate with oil, Specification Mil-0-6068.
Elevators other than loading elevators rise during operation.	Rollers mounted on elevator in operational sequence ahead of the one giving trouble are too tight.	Remove offending rollers and replace, or sand flat surfaces to compensate for swelling.
	Top shaft clutch out of adjustment.	Clutch on top shaft should be loosened slightly by backing off clutch nut on end of shaft.
	Machine improperly threaded.	Check the threading of the machine by lifting elevators and pulling front strands straight out. This method will prevent tangling of the strands and with elevator in its top position, checking of the threading is simplified. Be sure the strands are not threaded outside either the front or back plate of the elevator.

Example of a troubleshooting table.



Pictorial diagram.

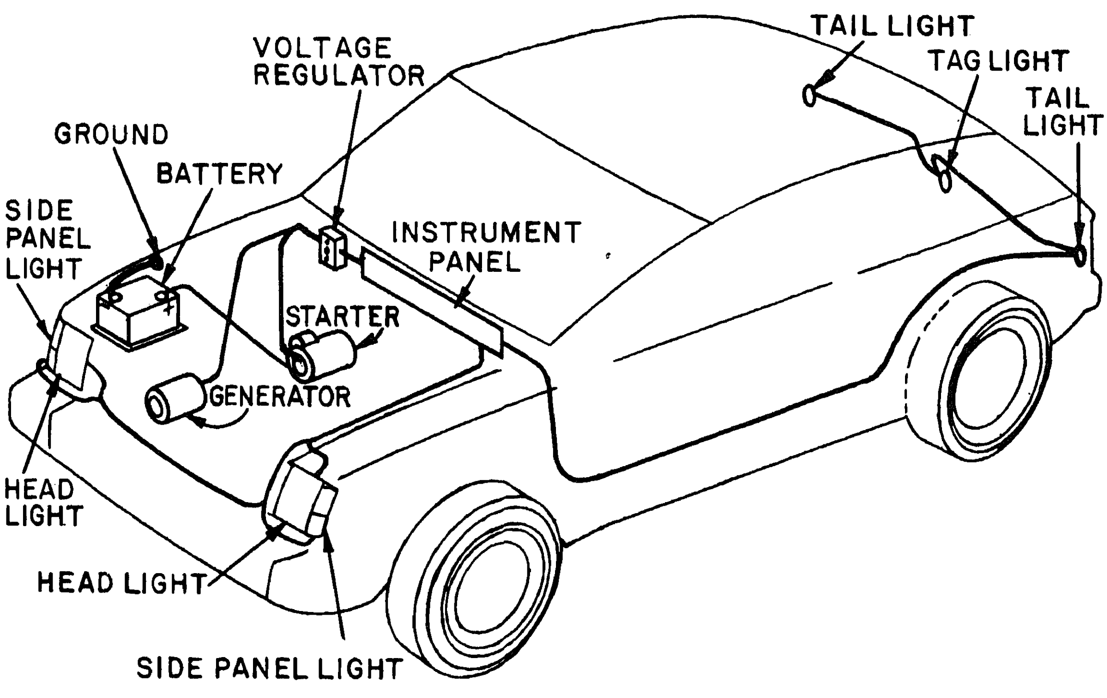
characteristics of its own and with a specific purpose. Each of the various diagrams that are discussed here has a specific purpose and distinguishing features which set it apart from the others. The diagrams discussed may be used for the following purposes:

- To learn a specific system operation.
- To locate the components of a system.
- To identify the components of a system.
- To trace a circuit.
- To troubleshoot equipment.
- To repair equipment.

The electrical system of an automobile is used here to explain the various electrical diagrams and how to "read" them.

Pictorial Diagram

The simplest of all diagrams is the pictorial diagram. It shows a picture or sketch of the various components of a specific system and the wiring between these components. This simplified diagram readily identifies the components of a



Isometric diagram.

system, even if you are not familiar with how they look. This type of diagram shows the components without regard to their physical location, how the wiring is marked, or how the wiring is routed. It does, however, show you the sequence in which the components are connected. If you are not already familiar with the components of the system, after studying the diagram you should be able to recognize them and know which is connected to which.

Isometric Diagram

The purpose of an isometric diagram is to help you locate a component within a system. If you do not know where to look for a component, the isometric diagram is of considerable value to you. This type of diagram shows you the outline of a processor, printer, or other piece of equipment. Within the outline are drawn the various components of a system in their respective or relative locations. The isometric diagram also shows the interconnecting cable runs between these components.

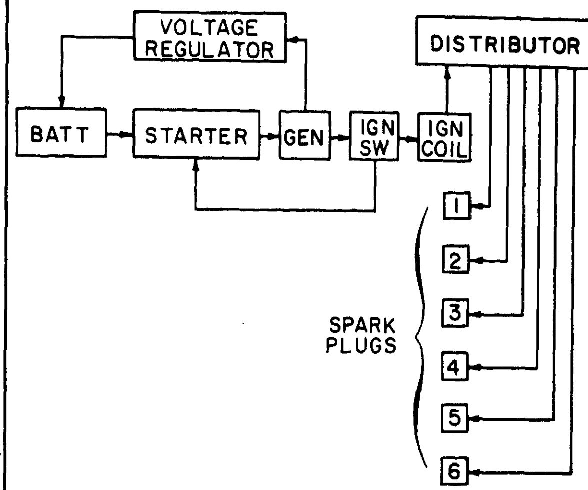
The isometric diagram of the starting and ignition system illustrated in the pictorial diagram shows the battery, starter, and other components, each in its actual location within the automobile.

Block Diagrams

A block diagram usually presents a general description of a system and its functions. This type of diagram is often used with accompanying text material. A block diagram shows the major components of a system and the interconnections of these components. All components are shown in block form and each block is labeled for identification purposes.

The block diagram here illustrates an automobile's electrical power, starting, and ignition system. It must be emphasized that the accompanying explanation is *primarily* for the purpose of assisting you in learning to "read" or interpret a block diagram. The explanation of the functions of the automobile power, starting, and ignition system is of secondary importance. By tracing from component to component in the block diagram and following the explanation, you are given a general description of the system's functions. Also you should be able to understand the reason the block diagram is arranged in the manner in which it is presented.

The battery is the *initial* source of power for the starter and ignition system. The starter is actuated by power from the battery when the ignition switch is turned to the start position. Power is also supplied, through the ignition switch, to the coil. From the coil, power is supplied to the distributor and finally to the spark plugs for ignition.



Block diagram.

Once the engine is running, the starter is no longer required. The running engine acts as the prime mover for the generator. (This is accomplished through a belt and pulley system attached to the engine's crankshaft.) The generator now takes over as the power supplier for the ignition system. It supplies power through the ignition switch to the coil, from the coil to the distributor, and finally from the distributor to the spark plugs. At the same time, the generator supplies power back through the voltage regulator to the battery for charging purposes. This completes the cycle until the engine is shut off and it is started again.

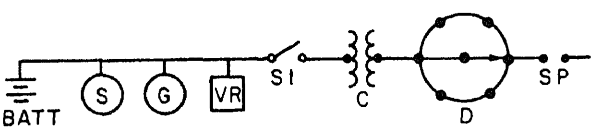
It should be noted that the engine is not shown in the block diagram as the prime mover for the generator. It is not shown because this is a mechanical rather than an electrical function. The illustrated block diagram is of the electrical system only. However, there are block diagrams which show strictly mechanical components. There are also block diagrams which show both mechanical and electrical components.

Single Line Diagram

The single line diagram is used basically for the same purpose as the block diagram. When used with text material, it provides you with a basic understanding of a system's components and their functions.

There are two major differences between the single line diagram and the block diagram. The first difference is that the single line diagram uses symbols, rather than labeled blocks, to represent components. Secondly, the single line diagram is just that—all components are shown in a single line. There are no interconnections shown for selected components as were shown in the block diagram (e.g., generator to voltage regulator and back to the battery).

This is a very simplified type of diagram and should be used primarily to learn, in very broad terms, the function of each of the various components as a part of the total system.



BATT - BATTERY
S — STARTER
G — GENERATOR
VR— VOLTAGE REGULATOR
SI – IGNITION SWITCH
C – IGNITION COIL
D – DISTRIBUTOR
SP– SPARK PLUG

Single line diagram.

Schematic Diagram

A schematic diagram uses graphic symbols to show the electrical components and functional organization of a circuit. The schematic diagram is used to trace the circuit and its functions without regard to the actual physical size, shape, or location of the component devices or parts. A schematic diagram is the most useful of all the diagrams in learning overall system operation.

The schematic diagram shown in the foldout at the end of this chapter is of an automobile electrical system. The automobile electrical system uses the frame of the automobile as a common conductor. The frame is called the ground side. The illustration shows all of the electrical components grounded on one side. The negative side of the battery is also grounded. Therefore, the frame is the negative conductor of the system. The opposite side of each of the components is connected through switches to the positive side of the battery. For the purpose of teaching schematic reading, not the entire automobile electrical system, but only the lighting system and engine instruments are discussed.

Points 1, 2, 3, etc. are added to the schematic to help you find your way through the diagram as you follow the discussion. The positive side of the 12 volt battery is connected to the starter solenoid, then to terminal B of the voltage regulator, and then down to point 1. (It should be noted at this time, that the points 1, 2, 3, etc., indicated on the schematic, normally are not indicated on most schematics. They are shown here only to help you follow the diagram.) Therefore, if no faults are in the system, point 1 has a 12 volt positive potential at all times. This positive potential can be traced through the fuse to the "off" position of the light switch. The dashed line indicates the mechanical linkage of the switch. When the switch is pulled to the first position (park), the +12 volts is then applied to point 2. It can now be seen that both taillights (T), the tag light, the side panel lights, and the instrument lights have a +12 volts applied. The opposite side of each light is grounded. The instrument panel lights are grounded through the dimming rheostat. This completes the path for current flow from

the negative side of the battery, through all the light bulbs (lamps), back to the positive side of the battery. If no faults exist, the lamps will light.

When the light switch is pulled to the next position "on," the bar on the switch contacts the "off," "park," and "on" contacts of the switch. The lights that were illuminated before are still on and the + 12 volt potential is now applied to the bright (B) side of the headlights through the dimmer switch. Since the headlights are also grounded on one side, there is now a complete path for current flow and the headlights also light. If the dimmer switch is actuated, the positive potential is switched from the bright filament to the dim filament of the headlights, and the lights dim.

The brake light switch has + 12 volts applied from point 1 directly to the stop lights (not fused). If the brake pedal is depressed, the switch is actuated and the + 12 volts is applied to both stop lights (S). Because one side of each light is tied to ground, there is a path for current flow, and the lights will light. If the dimming rheostat for the instrument lights is turned in the direction which increases the resistance, more voltage is dropped across the rheostat, less across the lights, and the lights will get dimmer.

The + 12 volts at point 1 is also supplied to the "off" position of the ignition switch. When the ignition switch is turned on the + 12 volts is felt at point 3. This is a common point to all the engine instruments.

The gas gauge is a galvanometer with the dial graduated according to the amount of fuel in the tank. The gas gauge tank unit is a rheostat mechanically linked to a float in the gas tank. When the tank is full, the float rises to its highest level and positions the movable arm of the rheostat to a position of minimum resistance. This allows maximum current flow through the galvanometer and the dial rests at the full mark on the gas gauge. As fuel is used the float lowers, increasing the resistance of the rheostat to ground. This reduces the current through the galvanometer and the dial shows a lesser amount of fuel.

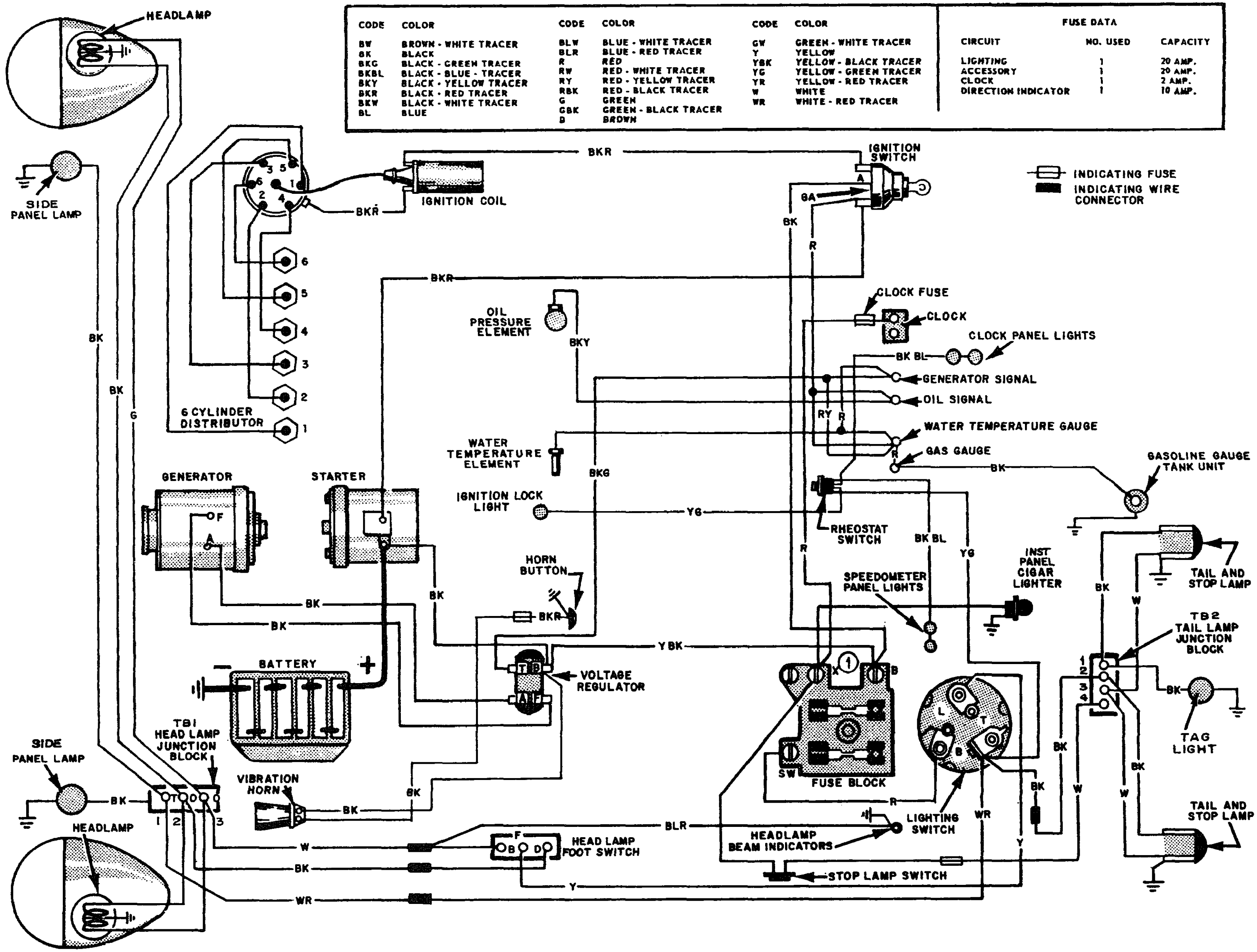
The oil pressure light gets its ground through a normally closed pressure switch. (When no pressure is applied, the switch is closed.) When the engine is started, the oil pressure increases and opens the switch. This turns the light off by removing the ground.

The water temperature gauge is a galvanometer like the gas gauge, except its dial is graduated in degrees of temperature. The water temperature element is a thermistor with a negative temperature coefficient. (A thermistor is a semiconductor device whose resistance varies with temperature.) When the engine is cold, the thermistor's resistance is at a maximum. This reduces the current through the galvanometer, and a low temperature is indicated on the dial. As the engine's water temperature increases, the thermistor's resistance decreases. This allows more current to flow from ground through the galvanometer and the dial shows an increase in temperature.

On the voltage regulator shown, the "T" terminal is grounded any time the generator does not have an output. This gives the generator light a ground and causes it to illuminate.

Wiring Diagram

A wiring diagram is a detailed diagram of each circuit installation showing all of the wiring, connectors, terminal boards, and electrical or electronic components of the circuit. It also identifies the wires by wire numbers or color coding. Wiring diagrams are used to troubleshoot



CODE	COLOR	CODE	COLOR	CODE	COLOR
BW	BROWN - WHITE TRACER	BLW	BLUE - WHITE TRACER	GW	GREEN - WHITE TRACER
BK	BLACK	BLR	BLUE - RED TRACER	Y	YELLOW
BKG	BLACK - GREEN TRACER	R	RED	YBK	YELLOW - BLACK TRACER
BKBL	BLACK - BLUE - TRACER	RW	RED - WHITE TRACER	YG	YELLOW - GREEN TRACER
BKY	BLACK - YELLOW TRACER	RY	RED - YELLOW TRACER	YR	YELLOW - RED TRACER
BKR	BLACK - RED TRACER	RBK	RED - BLACK TRACER	W	WHITE
BKW	BLACK - WHITE TRACER	G	GREEN	WR	WHITE - RED TRACER
BL	BLUE	GBK	GREEN - BLACK TRACER		
		D	BROWN		

FUSE DATA

CIRCUIT	NO. USED	CAPACITY
LIGHTING	1	20 AMP.
ACCESSORY	1	20 AMP.
CLOCK	1	2 AMP.
DIRECTION INDICATOR	1	10 AMP.

Wiring diagram.

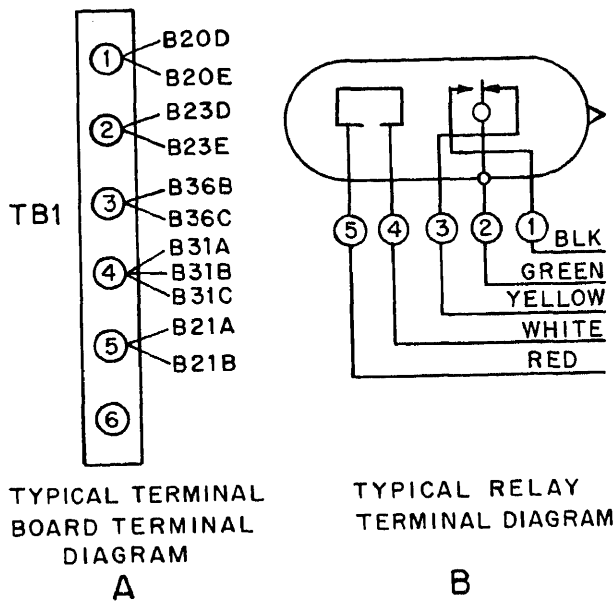
and repair electrical or electronic circuits. In the wiring diagram here, you can see all of the electrical components of an automobile. The interconnecting wiring color code is indicated by the letters on the lines that represent the wires.

The schematic diagram previously discussed should be used to determine where the trouble might possibly be in the circuit when a malfunction occurs. However, the schematic diagram does not show the terminals, connector points, etc., of the circuit. Therefore, you must use the circuit wiring diagram to determine where to make the voltage or resistance checks in the circuit. Following is an example of the use of a schematic diagram in conjunction with a wiring diagram to troubleshoot a circuit.

In the discussion of schematic diagrams, you will recall that when the light switch is pulled to the "park" position, the tail-lights, side panel lights, the tag lights, and the instrument lights come on. Now, suppose that when the light switch is pulled to the "park" position all of the lights come on, with the exception of the tag light. Referring to the schematic diagram (foldout), when the light switch is placed in the "park" position, a +12 volts is applied to point 2. If all of the lights except the tag light come on, then the fault must be between point 2 and the tag light ground. On the *schematic* it can be seen that there are numerous connections to point 2. Point 2 on the *wiring diagram* is actually composed of three different junctions. Terminal 1 on TB1, the head lamp junction block; terminals 1 and 2 of TB2, the tail lamp junction block; and the "T" terminal of the light switch, all correspond to point 2 on the *schematic*. The fault here is in the tag light which normally receives its +12 volts from terminal 1 of TB2. To use a voltmeter to find the fault, place the positive lead of the voltmeter to the "ground" terminal of the tag light and the negative lead to the frame. The voltmeter should read zero, because there should be no difference of potential between the two points. If the meter reads a voltage, the ground lead is either open or has a high resistance connection. In the event that the meter reads zero, as it should, you will have to go to another test point. In this case, place the positive voltmeter lead on the positive terminal of the tail-light. If the voltmeter reads +12 volts, the light bulb is probably burned out or the light socket is defective. If the voltmeter reads zero, then the open is between terminal 1 of TB2 and the light.

Terminal Diagram

A terminal diagram is useful when connecting wires to terminal boards, relays, switches, and other components of a circuit. The illustration shows two typical terminal diagrams: (A) shows the wire numbers connected to each terminal of a terminal board; (B) shows the color codes of the wires that are connected to a relay.



Terminal diagram.

This has been a brief overview into the use and interpretation of the various electrical diagrams. The diagrams just discussed were selected because of their simplicity and ease of interpretation. Many diagrams you will encounter are far more complex. Start with the simpler diagrams you will be working with on the job. Your proficiency in the use of the more complex diagrams will increase with experience and study.

TOOLS

In your maintenance and troubleshooting you will use a great variety of both common and specialized tools.

Tools are designed to make a job easier and enable you to work more efficiently. If the tools are not used properly or cared for their advantages will be lost. Without them you will not be able to perform all your maintenance and troubleshooting assignments effectively.

Regardless of the type of work to be done, you must have, choose, and use the correct tools in order to do your work quickly, accurately, and safely. Without the proper tools and the knowledge of how to use them, you waste time, reduce your efficiency, and may even injure yourself.

Your Most Valuable Tools

What would you pay for the most valuable tools in the world? These tools can help you grip, grasp, push, twist, and operate equipment. Furthermore, these remarkable tools can distinguish temperature variations and are sensitive to touch. It is impossible to purchase such tools . . . they are your hands.

These fabulous tools are subject to injury by being caught in machines, crushed by objects, or cut by a variety of sharp-edged tools such as chisels, knives, or saws. Additionally, your hands can be injured by being burnt, fractured, or sprained unless you are always alert.

Why? Because they cannot think for themselves. Protect them. They are invaluable. Keep alert while you work. Think as you work. Think before you make adjustments to machinery. Has the electric power been turned off? Are the required guards on the machinery? Is the object on which you are going to work properly secured and clamped?

Protect your hands from injury as directed by safety instructions whenever you use tools. You will be working under severe handicaps without the full use of both hands. Make it a habit to follow all safety rules.

Tool Safety

- Learn the safe way to do your job before you start.
- Think safety, and act safety at all times.
- Obey safety rules and regulations—they are for your protection.
- Wear proper clothing and protective equipment.
- Conduct yourself properly at all times—horseplay is prohibited.
- Operate only the equipment you are authorized to use.
- Inspect tools and equipment for safe condition before starting work.
- Advise your superior promptly of any unsafe conditions or practice.
- Report any injury immediately to your superior.
- Support your safety program and take an active part in safety meetings.

In addition to the above, there are other good tool habits which will help you perform your work more efficiently as well as safely.

Tool Habits

"A place for everything and everything in its place" is just common sense. You cannot do an efficient, fast repair job if you have to stop and look around for each tool you need. The following rules, if followed, will make your job easier.

- *Keep each tool in its proper place*—A tool is useless if you cannot find it. If you return each tool to its proper place, you'll know where it is the next time you need it.

- *Keep your tools in good condition*—Protect them from rust, nicks, burrs, and breakage.

- *Keep your tool allowance complete*—If you are issued a toolbox, each tool should be placed in it when not in use. If possible, the box should be locked and stored in a designated area. An inventory list retained in the box and checked after each job will help you keep track of your tools.

- *Use each tool only on the job for which it was designed*—If you use the wrong tools to make an adjustment, the results will probably be unsatisfactory. For example, if you use a socket wrench that is a trifle too big, you will round off the corners of either the wrench or the nut.

- *When working, keep your tools within easy reach and where they cannot fall on the floor or machinery*—Avoid placing tools anywhere above machinery or electrical apparatus. Serious damage will result if the tool falls into the machinery after the equipment is energized.

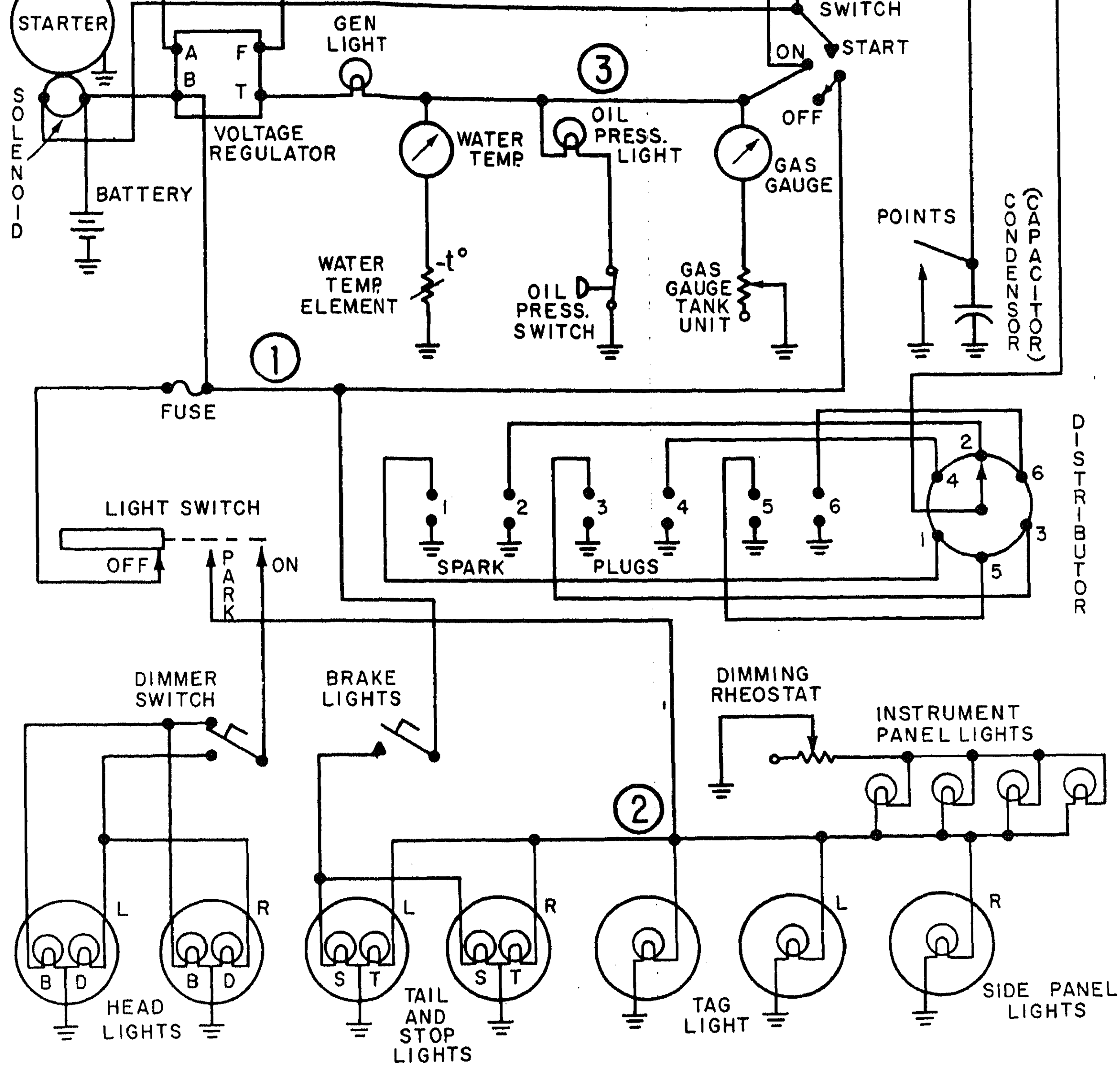
- *Never use damaged tools*—A battered screwdriver may slip and spoil the screw slot, damage other parts, or cause painful injury. A gauge strained out of shape will result in inaccurate measurements.

Remember, the efficiency of a craftsman and the tools he uses are determined to a great extent by the way he keeps his tools. Likewise, the craftsman is frequently judged by the manner in which he handles and cares for his tools. Anyone watching a skilled craftsman at work notices the care and precision with which he uses the tools of his trade.

The care of hand tools should follow the same pattern as for personal articles; that is, always keep hand tools clean and free from dirt, grease, and foreign matter. After use, return tools promptly to their proper place in the toolbox. Improve your own efficiency by organizing your tools so that those used most frequently can be reached easily without digging through the entire contents of the box. Avoid accumulating unnecessary junk.

Any Navy photographer who performs equipment maintenance or troubleshooting should obtain a copy of *Tools and Their Uses,* NAVEDTRA 10085. This publication should be considered one of the tools of your toolbox. This publication will provide you with information on a variety of tools.

IF IT AIN'T BROKE, DON'T FIX IT!



Schematic diagram.

CHAPTER 7

AUDIOVISUAL ADMINISTRATION

In order to efficiently operate within a Navy audiovisual activity or unit, all Navy photographers must be acquainted with the organization and administration of the Navy audiovisual structure.

This chapter is intended as an introduction to the Navy audiovisual structure. A more in-depth understanding of the organization and administration can be acquired from the *Navy Audiovisual Management and Operations Manual,* OPNAVINST 5290.1.

The *Navy Audiovisual Management and Operations Manual,* OPNAVINST 5290.1, governs the administration and operation of Navy audiovisual activities. It outlines the organization and administration of audiovisual units, and gives the policies and instructions for the use of photography and all other audiovisual products in the Navy.

NAVY AUDIOVISUAL ORGANIZATION

The Chief of Information (CHINFO) (OP-007) is the flag officer who represents all Navy audiovisual activities and is responsible to the CNO for the administration of the Naval Audiovisual Activities Program (NAVAP). The Assistant for Navy Audiovisual Management (OP-007D) is the principal adviser and assistant to the CHINFO for audiovisual (AV) matters, and is responsible for executing and implementing the Naval Audiovisual Activities Program.

MAJOR AUDIOVISUAL ACTIVITIES

The Naval Audiovisual Center (NAVAVCEN), located in Washington, D.C., is the major AV activity in the Navy. The Center provides general AV productions, products, and services to the Navy and other authorized organizations.

The Atlantic Fleet Audiovisual Command and the Pacific Fleet Audiovisual Command operate an extensive network of Base Audiovisual Service Centers (BAVSCs) and Base Audiovisual Service Center Detachments (BAVSCDs). Each of the audiovisual commands provides a wide variety of AV support, including extensive photographic, video, and audio services to fleet and shore activities. The fleet AV commands also have aerial, ground, and underwater photographic capabilities and deployable units.

AUDIOVISUAL FACILITIES

AV facilities (including photo labs) support military operations, contingencies, and emergencies. They range in type from the Naval Audiovisual Center to small detachments. These facilities produce AV products and/or provide other AV services.

Types of Navy AV Facilities

The Naval Audiovisual Center and the fleet audiovisual commands, as discussed, are extensive facilities which provide a wide range of services to the Navy and the fleet.

There are two other types of Navy AV facilities: Base Audiovisual Service Centers (BAVSCs) and Mission Dedicated Audiovisual Facilities (MDAVFs). Both types of AV facilities are authorized by OP-007D to meet specific requirements. In some cases, a BAVSC may be

authorized to establish detachments under its control to provide specialized support. These detachments are referred to as BAVSCDs.

BASE AUDIOVISUAL SERVICE CENTER (BAVSC).—A BAVSC is a single, consolidated management and service organization, which centrally manages and supports all AV activities and functions (except for a MDAVF) for a naval base or a geographic area. A BAVSC may be a single, consolidated AV facility. It usually is made up of components and functions that are physically separate. For example, a BAVSC management office may be located in one building, while other AV activities under its control, such as a still photographic laboratory, a graphic arts shop, and a storage area, may be located in various other buildings. Only one BAVSC is authorized for a naval base or geographic area.

BASE AUDIOVISUAL SERVICE CENTER DETACHMENT (BAVSCD).—A BAVSCD is a physically separate, operational element of a BAVSC, and has specific functional responsibilities. A BAVSCD is not separately funded or managed and is not identified by a Department of Defense Audiovisual Activity Authorization Number (DODAVAN). A BAVSCD will normally be authorized if:

- Operational needs require a detachment.
- It is not practical to physically consolidate all AV activities.
- Facilities are not physically suited to consolidated operations.

MISSION DEDICATED AUDIOVISUAL FACILITIES (MDAVF).—A mission dedicated AV facility is a fixed or mobile AV facility that is managed and funded separately by the organization authorized to operate it. An MDAVF is established and authorized to meet a unique requirement for AV products or services beyond the capability of a BAVSC or BAVSCD. It is limited to specific support services and functions. Because of its mission, distance from a BAVSC, or time constraints, the services provided by an MDAVF may duplicate those authorized and assigned to a BAVSC on the same base. An MDAVF is established ONLY to meet the needs of a specific mission.

AUDIOVISUAL FACILITY FUNCTIONS

An AV facility may be authorized to perform one or more of the following functions:

- Management and administration of AV activities
- Photography
- Video recording
- Audio recording
- Graphic arts
- Fabrication and reproduction of displays and devices
- Operating an AV library
- Loan of AV devices
- Loan of AV equipment
- Presentation support
- Audiovisual instruction
- Audiovisual consultation and design
- Instrumentation—originating, processing, or duplicating instrumentation (includes still and motion picture photography, audio and video recordings, and specialized time-lapse, high-speed, and oscilloscope recordings)
- Audiovisual production
- Audiovisual maintenance

Navy AV Facilities and Other Federal Activities

You may encounter some Navy AV facilities which support other activities, commands, DOD components, and Federal agencies. This support might include AV documentation, production, acquisition, reproduction, distribution or depository (storage or library) operations, and the more common AV services.

ASSIGNMENT OF AUDIOVISUAL PERSONNEL

As a Photographer's Mate, if you are assigned to an activity which is not authorized to operate an AV facility, you should be further assigned, on temporary duty or special detail, to the AV facility on the ship or station where the activity is based. However, there are exceptions to this.

When aircraft squadrons are not operating an authorized AV facility, they should assign sufficient AV personnel to the supporting AV facility to fulfill the squadron's AV support requirements. Aircrewmen in a flying status and personnel specially trained in aerial camera installation or aircraft camera control systems for designated reconnaissance aircraft should not normally be assigned to the ship's or station's AV facility except in emergency situations, and then, only when the assignment will not adversely affect the squadron's capability.

When a ship's AV facility is not operating, its AV personnel should be assigned temporarily to the activity that provides AV support for the ship.

If you are assigned to a major AV unit (Naval Audiovisual Center, Atlantic or Pacific Fleet Audiovisual Command, etc.) and are ordered to a naval activity or embarked in a naval vessel, you are assigned specific AV projects to accomplish. In this case you should not be assigned to the local AV facility or assigned other military duties that will interfere with the accomplishment of your assigned mission.

When Mobile Construction Battalions, having Photographer's Mates, are not operating their own AV facility, they should assign sufficient AV personnel (on temporary duty) to enable the supporting AV facility to fulfill their AV support requirements.

Reserve Personnel

Selected Reserve PHs on training duty should be assigned to the Naval Reserve unit, naval vessel, or station AV facility which can effectively train them for their assigned mobilization billet. Photo lab managers should coordinate with the command that will gain the reservist during a mobilization to develop and implement a training program to prepare the reservist for duty with the gaining command. This training may include state-of-the-art AV training, military training, formal schools, mobilization training, Personnel Qualification Standards (PQS), On the Job Training (OJT), and Job Qualification Requirements (JQR).

TRAINING OF AUDIOVISUAL PERSONNEL

The audiovisual manager or officer, and senior audiovisual personnel should ensure that their subordinates, including civilians and reservists, are trained in the latest AV techniques as well as rate or career training. This training should include both on the job and formal training. On the job training must, of course, be directed toward the job or mission at hand. However, training which will help the individual's career progression should not be neglected.

Naval Schools of Photography

The Naval Schools of Photography located in Pensacola, Florida, offer formal training courses in basic and advanced photographic and other AV techniques. Some of the subjects covered in the courses offered by the school include:

- Basic photography
- Advanced photography
- Photographic laboratory techniques
- Photographic quality assurance
- Printing and processing machines
- Color printing
- Copy and product photography
- Portrait photography
- Still documentary photography
- Slide presentation
- Motion picture and TV production
- AV equipment maintenance

Special Training

Advanced and specialized training is also available to qualified officer and enlisted

personnel and Navy civilians. Some of these special training courses cover the following subjects:

- Quality control of photographic materials and processing
- Motion picture editing
- Motion picture sound engineer
- Motion picture scriptwriting
- Photojournalism
- Cinematography

> The *Catalog of Navy Training Courses,* NAVEDTRA 10500, lists all the formal training courses offered to Navy photographers.

AUDIOVISUAL PRODUCTS AND SERVICES

All Navy AV facilities are established to provide AV support for official business only. Each AV organization may furnish one or more services such as photography, graphic arts, audio, television, or video support to meet all authorized requirements.

OBTAINING AV PRODUCTS AND SERVICES

Navy activities requesting AV products and services should submit an Audiovisual Activity Job Order, OPNAV Form 5290/1, to the AV facility.

Your facility may also receive requests from other DOD components, departments, and agencies of the Federal Government in the form of letters or messages, or on the OPNAV Form 5290/1.

The Audiovisual Activity Job Order Form (OPNAV 5290/1)

When the requester gives you the OPNAV Form 5290/1 with his entries, you must assign the job a Standardized Audiovisual Work Request Number (SAVWRN). This consists of the Department of Defense Audiovisual Activity Authorization Number (DODAVAN), a dash, a two-letter DOD-type work code, a dash, the last two digits of the Fiscal year, a dash, and a five-digit sequentially assigned work request number.

An example of a SAVWRN is: N0108-SP-84-01070

Authorized DOD-type work codes are:

AD — Aids, Displays, and Devices.

AS — Audio Services (except for audio recording made in conjunction with Motion Picture Photography and Television Broadcast/Documentation. These recordings will be counted under MS and TV, respectively).

GA — Graphic Arts.

MP — Motion Picture Photography.

MS — Sound recorded separately in conjunction with Motion Picture Photography.

RA — Radio Broadcast or Cablecast.

SP — Still Photography.

SV — Audiovisual Services (e.g., conference room AV support, projectionist services, consultant services, etc.).

TV — Television Broadcast or Cablecast.

VT — Videotape Recording.

Much of the information recorded on the job order will correlate to specific data entry requirements of the Audiovisual (AV) Annual Report. Instructions for transcribing job order data to the Audiovisual (AV) Annual Report are contained in the *Navy Audiovisual Management and Operations Manual,* OPNAVINST 5290.1.

SAFEGUARDING CLASSIFIED MATERIAL

Modern methods of conducting war and safeguarding our nation require the use of

tremendous amounts of information. This information is stowed away in books. It accumulates in reports. It is gathered by intelligence activities. It is transferred in letters, messages, photographs, and audio and video recordings, and it is sifted and organized in the minds of the men who are directing the war and keeping the peace. Much of this information could be extremely valuable to our enemies, and, therefore, must be classified and safeguarded in the interest of our national security.

As a Navy photographer, you may from time to time have access to classified information in the course of doing your job. Therefore, you MUST be aware of the importance of safeguarding any classified information you have access to.

The classification and security of information in the Navy is in accordance with OPNAVINST 5510.1, *Department of the Navy Information and Security Program Regulation*. A copy of this regulation should be available in every Navy photo lab or audiovisual facility where any classified information is maintained or worked with. When dealing with classified information, especially if you only handle it infrequently, do not depend on your memory. Refer to the regulation to make sure you safeguard it correctly.

The purpose of the security program is to protect classified material from unauthorized disclosure. And it is the responsibility of every Navy photographer to safeguard classified information.

To this end the Navy uses a security formula which is simple in principle. It is based on circulation control—the control of the dissemination of classified information. Therefore, knowledge or possession of classified information is permitted only to those who *actually* require it in the performance of their duties, and then only after they have been granted the appropriate security clearances. This principle is generally referred to as a "need to know" and is a prime requisite for access to classified information.

Access to classified material is not automatically granted because a person has the proper clearance, holds a particular billet, or is sufficiently senior in authority, but only if the criteria of proper clearance and "need to know" are both met.

CLASSIFICATION CATEGORIES

Official material that requires protection in the interest of national defense is *limited to three* categories of classification which, in descending order of importance, carry the designations Top Secret, Secret, or Confidential. No other designation is used to classify defense matter, as requiring protection in the interest of national defense, except as expressly provided by statute (e.g., Restricted Data and cryptographic systems). The words, matter, material, and information, as used in connection with classification, are synonymous.

Top Secret

Use of the classification Top Secret is limited to defense information or material that requires the highest degree of protection. The Top Secret classification is applied only to that information or material the defense aspect of which is paramount, and the unauthorized disclosure of which would reasonably be expected to cause exceptionally grave damage to the national security.

Secret

Material classified as Secret is limited to defense information or material the unauthorized disclosure of which would reasonably be expected to cause serious damage to the national security.

Confidential

Use of the classification Confidential is limited to national defense information or material the unauthorized disclosure of which could reasonably be expected to cause damage to the national security.

The security classifications are described in detail in OPNAVINST 5510.1.

RESTRICTED DATA

The term "Restricted Data" as defined in the Atomic Energy Act of 1954 means all data concerning (1) the design, manufacture, or utilization of atomic weapons; (2) the production of special nuclear material; or (3) the use of special nuclear material in the production of energy.

The term "Formerly Restricted Data" applies to classified defense information which (a) has been removed from the Restricted Data category pursuant to the Atomic Energy Act of 1954, and (b) cannot be released to foreign nationals except under specific international agreements.

Restricted Data and Formerly Restricted Data are NOT in themselves classification categories but are additional warning notices of special handling requirements. Thus a classification category is used with the warning notice wherever it is appropriate.

FOR OFFICIAL USE ONLY

The designation "For Official Use Only" is assigned to official information that requires protection in accordance with statutory requirements or in the public interest, but which does not require safeguarding in the interest of national defense.

A security classification may not be used to conceal violations of law; inefficiency; or administrative error; to prevent embarrassment to a person, organization or agency; or to restrain competition.

AUTHORITY TO CLASSIFY

The authority to assign a security classification is restricted to those officials who have been designated the authority in writing.

Derivative Classification

One important aspect of classification that is not clearly understood is the difference between original and derivative classification. Original classification is warranted only when an item of information is generated that requires classification and such classification cannot reasonably be derived from a previous classification of related information. For example, information pertaining to a technological breakthrough or a significant scientific advance will generally require the exercise of original classification authority.

The majority of classified material you work with is the product of derivative classification. As the word implies, this type of classification is based on and obtained from a previous classification. If the information to be presented is the same or closely related to other information for which a proper classification has already been assigned, derivative classification would be applied.

Suppose you are making photographs for a report of a Soviet warship in the South China Sea. If the report is based on a source document which states that such photographs should be classified, your classification is derived from that source. Or suppose you make pictures of a radar set that is classified Secret. Then the picture, including the negatives and any test prints, must also be classified Secret. The classification of the pictures is derived from the classification of the radar set. Only when guidance in any form is nonexistent is the classification an original one. Most of the information derivatively classified is taken from previously classified documents. Whenever you copy or extract classified information you must ensure that the extracted information bears the same classification in the new document (such as a photograph) as it did in the source document.

In marking a derivatively classified document, you must cite the source of that classification or authority (e.g., CNO ltr, ser OP-009 of 1 Oct 77) on the "classified by" line. Records must be available for the lifetime of the document to show the basis for classification or to trace the chain of classification authority.

CLASSIFICATION MARKINGS ON AUDIOVISUAL PRODUCTS

The requester of any AV product should determine the security classification of the product according to instructions contained in OPNAVINST 5510.1. Each original AV product and copies of AV products which are classified must be marked with the appropriate security classification, authority, and declassification and downgrading instructions based on the original classification markings.

Marking Photographs

Both photographic prints and negatives which are classified must be marked with the appropriate classification and other applicable markings. Roll negatives will be marked at the beginning and end of the roll or strip on the base side. Single negatives cut from the roll or single sheet film negatives must also be appropriately marked on the base side. All 8 × 10 and larger classified prints are marked at the top and bottom on the back side with the appropriate classification. The downgrading and declassification instructions will be at the bottom on the back of all photographs. On prints smaller than 8 × 10 the classification marking need be applied only once. No matter what size the photographs are, whenever practicable, the markings should also appear once on the face side. In any case, the classification MUST be shown on the face side and may be attached by pressure sensitive tape or stapled strip if a stamp should not be used.

> Caution must be used when using instant picture film to photograph classified material. All component parts of the instant picture film must be removed from the camera and waste parts destroyed as classified waste.
>
> If the "negative" of instant picture film of a classified subject is left in the camera, then the camera shall be protected as classified material.
>
> As a matter of fact, any camera which contains exposed film of a classified subject must be afforded the same protection as the classified subject.

Marking Transparencies and Slides

Whenever possible, the applicable classification markings shall be shown clearly on the film or image area of each classified slide or transparency. If, in special circumstances, the classification marking cannot be shown in the image area, it must be shown on the slide or transparency border, holder, mount, or frame with the other applicable associated markings.

Marking Motion Picture Films

Classified motion picture films shall be marked at the beginning and end of each reel by titles bearing the appropriate classification and applicable associated markings. The markings must be visible when projected onto the screen. Reels containing classified film are to be kept in containers (film cans) conspicuously marked with the classification and applicable associated markings.

Video and Audio Recordings

Electronic recordings, sound or image, shall contain a statement of the assigned classification at the beginning and end. This statement, verbal or written, as appropriate, must provide adequate assurance that any listener or viewer will know that classified information of a specified level of classification is involved. Recordings shall be kept in containers or on reels that have conspicuous classification and applicable associated markings.

AUTOMATIC DOWNGRADING AND DECLASSIFICATION

The national interest demands that classified information be declassified and made available to the general public when its secrecy is no longer necessary or justified. In line with this principle, a command may declassify or assign a lower degree of classification to material it originated.

General Declassification Schedule

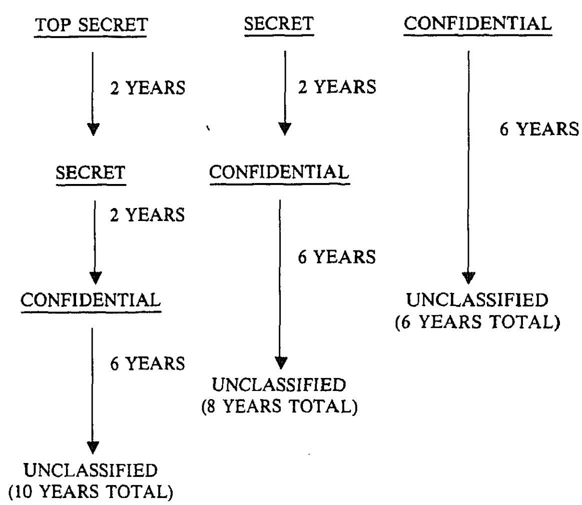
In 1972 the President issued an executive order that less official information would be classified, and more of it declassified so that the information which is classified could be better protected. As a result of this executive order, at the time of original classification, each piece of classified

material created after 1 June 1972 must be marked with a downgrading and declassification date. This date is set by a general declassification schedule (GDS) as follows:

- Top Secret: Information and material is downgraded to Secret 2 calendar years after origination, downgraded to Confidential 4 years after origination, and declassified 10 years after origination.

- Secret: Information and material is downgraded to Confidential 2 calendar years after origination and declassified 8 years after origination.

- Confidential: Information and material is declassified 6 calendar years after origination.



General Declassification Schedule

Certain information is excluded from the GDS when the information is of a very delicate nature. Exemptions are made when—

- Furnished by foreign governments or international organizations and held by the United States with the understanding that it be kept in confidence.

- Specifically covered by statute (e.g., Restricted Data and Formerly Restricted Data) or pertaining to cryptography, or disclosing intelligence sources or methods.

- The continuing protection of a system, plan installation, project, or specific foreign relations matter is essential to the national security.

- Disclosure would place a person in immediate jeopardy.

DISCLOSURE OF CLASSIFIED MATERIAL

When classified matter is entrusted or made known to you, you must protect it against loss or compromise. You are responsible for any act or failure on your part that may in any way contribute to its loss, compromise, or unauthorized disclosure. This includes information that is transmitted orally.

If you are found responsible for the loss, compromise, or unauthorized disclosure of classified matter, or if you violate security regulations, you can expect to be promptly and adequately disciplined. Disciplinary action may include, in the case of military personnel, trial by court-martial or, in the case of civilians, prosecution under Title 18, United States Code, as amended, or other Federal statutes as appropriate.

SPECIFIC PROTECTIVE MEASURES

There are, in general, four ways in which classified information is protected: censorship, physical security, transmission security, and cryptographic security. As a photographer, you will be primarily concerned with personal censorship and physical security.

Personal Censorship

Censorship places a barrier between classified information and unauthorized persons by preventing its disclosure in letters, conversations, and personal contacts. It means the shutting off of information at the source, except in making official use of it, and depends to a large extent on the integrity and discretion of the individual.

Physical Security

Physical security as used here is concerned with the safeguarding of documents, photographs, and

other items which contain classified information. Later in this chapter we will discuss another form of physical security used to physically safeguard property and material at Navy shore activities.

The physical security we speak of for now is concerned with protecting *classified* documents, devices, and material so that they never fall into the hands of unauthorized persons or come within either optical or camera range of actual or possible enemies.

When working with classified matter you must protect that matter from being seen by any unauthorized individual, either military or civilian. There is no reason for any person to have access to classified material until it becomes necessary to do so to discharge their duties properly.

Classified material may neither be removed from its designated working space nor left unguarded. When not actually in use, it is kept locked in the proper accommodation, for a single glance at a message or a cryptographic aid may be enough to betray the system. Another danger is that a photograph could be taken in a split second with a concealed camera.

DESTRUCTION OF CLASSIFIED AUDIOVISUAL PRODUCTS

When classified audiovisual products, such as photographs, videotapes, or audio recordings, are no longer needed or useful, they are destroyed, *never* discarded in wastebaskets for ordinary disposal.

Destruction of classified material must be accomplished and witnessed by persons who are cleared to the level of the material being destroyed. Two witnesses are required for the destruction of Top Secret material and one witness is required for the destruction of Secret and Confidential information.

A record of destruction is required for Top Secret and Secret material but not for Confidential material. Destruction may be recorded on OPNAV Form 5511/12 (Classified Material Destruction Report) or on any other record which includes complete identification of the material, number of copies destroyed, and the date of destruction. The record of destruction must be signed by the people who witnessed the destruction and retained for 2 years.

Classified documents can be destroyed by burning, pulping, pulverizing, or shredding. When destruction is accomplished by means other than shredding, the residue must be inspected to ensure complete mutilation.

SECURITY AREAS

Audiovisual spaces or buildings that contain classified matter are known as security (sensitive) areas. The areas have varying degrees of security, depending on their purpose and the nature of the work and information or materials concerned. All security areas should be clearly marked by signs reading, "Restricted Area." To meet different levels of security sensitivity, three types of security areas are established.

Exclusion Area

Spaces requiring the strictest control of access are designated exclusion areas. They contain classified matter of such nature that admittance to the area permits, for all practical purposes, access to such matter.

An exclusion area is fully enclosed by a perimeter barrier of solid construction. All entrances and exits are guarded, and only those persons whose duties require access and who possess appropriate security clearances are authorized to enter.

Limited Area

A limited area is one in which the uncontrolled movement of personnel permits access to classified information. Within the area, access may be prevented by escort and other internal controls.

The area is enclosed by a clearly defined perimeter barrier. Entrances and exits are guarded or controlled by attendants to check personal identification. The area may be protected by an automatic alarm system.

Most Navy photo labs and AV facilities should be considered at least as limited areas when classified work is in progress. Any visitors should be escorted when in the spaces. If classified work is in progress it should be excluded from the visitors' view. Even when classified work is not in progress, you should operate your AV facility as a limited area. Most of the time there will be expensive photographic and other AV equipment laying about, some of it small and easily

pilferable, such as 35mm cameras and lenses. By always operating an AV facility at least as a limited area, you will not only be safeguarding classified information but expensive equipment also.

Controlled Area

A controlled area usually does not contain classified information. It serves as a buffer zone to provide greater administrative control, safety, and protection for the limited or exclusion areas. These areas require personnel identification and control systems adequate to limit admittance to those having bona fide need for access to the area.

Passageways or spaces surrounding or adjacent to limited or exclusion areas may be designated controlled areas.

SAFEKEEPING AND STORAGE OF CLASSIFIED MATERIAL

Classified information or material cannot be used, held, or stored where there are not facilities adequate to prevent unauthorized persons from gaining access to it. The security requirements must permit the accomplishment of essential functions while affording a reasonable degree of security with a minimum calculated risk. In the Navy, the commanding officer is directly responsible for safeguarding all classified information within his command and for assuring that classified material, not in actual use by appropriately cleared personnel or under his direct personal observation, is stored in the prescribed manner.

Storage

Whenever classified material is not under the personnel control and observation of an authorized person, it will be guarded or stored in a locked security container.

Top Secret material should be stored in a safe or safe-type steel file container having a three-position combination lock as approved by the General Services Administration (GSA), or a class A vault which meets the standards established by the Director of Naval Intelligence. An alarm-protected area may be used to protect Top Secret must provide a physical barrier which prevents removal of the material, and prevents the material being seen when observation would result in the compromise of the material.

Secret and Confidential material may be stored in the manner authorized for Top Secret; or, in a class B vault, a vault-type room, or a secure storage room which has been approved in accordance with the standards prescribed by the Director of Naval Intelligence.

> Because they increase the risk of theft, valuables such as money, jewels, precious metals, narcotics, etc., shall not be held in containers (safes, vaults, etc.) used to store classified materials. In other words, *only classified material may be stored in a classified material container.*

Container Designations and Combinations

Each container used for the storage of classified material is assigned a number or symbol for identification purposes. The identifying *numbers* or *symbols* will be located in a conspicuous location on the outside of the container. Each container will also be designated as to the highest category of classified material to be stored therein. However, this designation *will not* be externally marked on the container.

The combination of a container used for the stowage of classified material is assigned a security classification equal to the highest category of classified material authorized to be stored in the container. Records of combinations are sealed in envelopes (OPNAV Form 5511/2) and kept by the security manager, duty officer, communications officer, or other persons designated by the commanding officer. Combinations will be changed under any of the following conditions:

- When a safe, etc., is first placed into use.
- Annually.
- When the combination or record of

● Whenever an individual knowing the combination has been transferred or discharged, and when the security clearance of an individual knowing the combination is reduced, suspended, or revoked.

When selecting new combination numbers for a security container, multiples of 5, simple ascending or descending numerical series, and personal data, such as birthdays and serial numbers, should be avoided. The same combination cannot be used for more than one container.

Combinations to security containers are to be changed only by a person who is cleared for the highest level of classified material stored in the container.

When a security container is taken out of service, built-in combination locks will be reset to the standard combination 50-25-50. Combination padlocks will be reset to 10-20-30.

RECEIPT SYSTEM FOR CLASSIFIED MATERIAL

Whenever Top Secret material changes hands it must be done under a continuous chain of receipts. For example, when a requester brings a Top Secret photograph to the lab to be copied, the photographer receiving the job must sign a receipt for the Top Secret picture. When the photographer turns the picture over to the cameraman, the cameraman must sign the receipt; when the cameraman turns the processed film over to the printer, the printer signs for the negative and the print; and so on until the requester again signs the receipt for the completed job.

Secret material, on the other hand, needs to be covered by a receipt only when it is transferred, either permanently or temporarily, to another command or other authorized addresses.

The receipts for Top Secret and Secret material will be provided by the transmitter or the person requesting the copy work in the above example. A postcard receipt form, such as OPNAV Form 5511/10 (Record of Receipt), may be used for this purpose. Receipt forms will be unclassified and contain only as much information as is necessary to identify the material being transmitted. No classified information shall be included on a receipt. Receipts are retained for at least 2 years.

Receipts for Confidential material are not required but may be used.

DEPARTMENT OF THE NAVY INFORMATION SECURITY PROGRAM REGULATION, OPNAVINST 5510.1

The foregoing information regarding "Safeguarding Classified Material" is provided to you as a general guide only. *It is not to be interpreted as an authority.*

Whenever you handle classified information or if you have any questions about classified information security matters you MUST refer to the *Department of the Navy Information Security Program Regulation,* OPNAVINST 5510.1.

Another very good source for security information is your command's security manager.

PHYSICAL SECURITY

Physical security is a part of an overall Navy program which is concerned with the physical measures designed to prevent unauthorized access to equipment, facilities, and materials and to safeguard them against espionage, sabotage, damage, theft, or other acts which would in some degree lessen the ability of a Navy activity to perform its mission or affect overall material security interests.

Audiovisual facilities and photo labs are a part of this physical security program. Physical security of an AV facility is a direct, immediate, legal, and moral responsibility of every photographer assigned to the unit or activity. You should become familiar with the *United States Navy Physical Security Manual,* OPNAVINST 5510.45, which sets forth policy and establishes uniform minimum standards for security measures to be used to physically safeguard our Navy's property and material.

As we said before, Navy AV facilities should be considered limited access areas. The reception or job order desk area of an AV facility is the only place within the facility that visitors or people from outside the assigned crew should be allowed to visit unescorted. Beyond the reception area there should be a definite, well-defined limiting barrier—either a warning sign or locked gate or door depending on the degree of security required—beyond which unauthorized people will know they should not enter.

ESCORTING VISITORS

Procedures for the control of people entering the restricted areas of an AV facility should include, as a minimum, an escort system. Escorting is a method for controlling personnel within the lab who are not normally authorized access. Whether or not the escort remains with the visitor during the entire time of the visit is determined by the amount of security required, the purpose of the visit, and by local written policy. Utility and maintenance personnel performing work at regular or irregular intervals and for short working periods should be handled by the same procedures adopted for the control of visitors.

A master chief photographer was assigned to a small photo lab where no classified work was performed. Prior to his arrival, access to the photo lab was free and uncontrolled to just about everyone on the station. When the master chief took charge of the lab, he immediately initiated a visitor control system and had a physical barrier erected between the job control desk and the production spaces.

Even after explaining his reasons for this action, as you can expect, there was, for a time, much grumbling and complaining from both the PHs who worked in the lab and from people who previously had free access to the lab.

The reasons the master chief gave for the new visitor control system were:

- Even though the lab does not engage in any classified work, the photographers must be made aware of the need for security. One of the results of the visitor control system then was training for the PHs who may someday be assigned to a lab where visitor control would be necessary to safeguard classified information. By following a visitor control system in this small lab the photographers would become accustomed to escorting visitors, the results of which might prevent the compromise of classified information or the disappearance of equipment at another duty station.

- People are curious and like to look at pictures. When visitors are allowed free, unescorted access to the lab, they will probably go through the pictures and negatives in the finishing area. They probably won't steal any pictures, but will they put them back where they came from? Or will the finishing crew have to re-sort all the jobs? (The crew finally admitted that when the lab was "open" to everyone, pictures often turned up missing or misplaced.)

- To the visitors who were upset over the new system the master chief explained it this way: "If you have unlimited access to the lab, and, say a 35mm camera comes up missing, you automatically become suspect and NIS will want to talk to you about it. However, if you are escorted during your visits to the lab everyone will know you couldn't have taken the camera."

These were not the only reasons the master chief gave for a visitor control program, but they serve to show you the importance of such a program.

..EY CONTROL

The number of keys issued to the crew of an .V facility or spaces should be kept to the bsolute minimum required for efficient operation f the facility. Generally, keys to the facility and ll facility spaces should be issued on a emipermanent basis only to the audiovisual nanager or officer, the audiovisual chief, and the roduction petty officer. Other members of the rew can be issued keys to the spaces within the acility where they work; e.g., the supply PO hould have a key to the storeroom, the TV studio 'O to the TV studio, etc. A set of all the keys hat the duty section needs should be part of the uty section leader's watch equipment. When he ssumes the duty, he should make an entry in the uty section logbook indicating receipt of *all* the eys from the offgoing section leader.

All keys should be given a serial number and lainly marked "Prop U.S. Gov't. Do Not)uplicate." Never mark a key with a building or pace name or number. If the key is lost, and the uilding or space number or name is on it, the finder would know where to go to use the key. By placing only a serial number on a key, it can be identified if and when it is turned in to the OOD, etc.

Keys issued on a semipermanent basis should be signed for in the master key log. When a person to whom a key has been issued is transferred or no longer has a distinct need for the key, it should be returned to the key custodian. If a key is lost, the lock to which the key goes must be changed.

DOORS, WINDOWS, AND SKYLIGHTS

There should be no more doors to a limited access area than are needed for efficient operation and safety. When not in active use, doors should be locked and inspected frequently.

Windows, skylights, and other openings which have an area large enough for someone to enter through should be protected by securely fastened bars, grills, or other equivalent means. Some provision should be made to break open these barriers if necessary to escape from a fire.

CHAPTER 8

AUDIOVISUAL SUPPLY

In every audiovisual facility someone has to be in charge of maintaining supplies and ordering more as needed. Sooner or later you may have this responsibility. Every sailor is a little afraid of the Navy Supply System at first. This is understandable since it is such a big system. What is even more awesome is that it is only part of a bigger supply system which includes all of the Government, and even serves allied military in NATO. Getting what you need from such a system is a lot different from shopping at the Five and Dime. Here we will give you some information and insights into using the supply system so that you can approach it with confidence. The first step in understanding the supply system is to realize the extent of the source of supply which you can draw on.

THE SOURCE

Your supplies are produced, for the most part, by American industry. They are made under contract, purchased in wholesale lots, and sometimes bought as individual pieces by various Government agencies, including the Navy. When you order supplies you tap into this vast reservoir of material. To fill your order the Navy Supply System draws on its own resources, or upon other services, or on material and equipment held by civilian agencies of the Government. To do this requires a system of cataloging everything the Government has in store.

A very large part of the business of the Chief of Naval Operations is managing all the property, or "hardware" as we call it, of the Navy. If you stop to think of all the bases, buildings, ships, planes, vehicles, and parts the Navy owns, you can imagine how big the job is. To assist him, CNO is aided by the Chief of Naval Material, who heads the Naval Material Command (NMC). To handle the details, the NMC is supported by the "Systems Commands" which are:

- Naval Air Systems Command
- Naval Electronics Systems Command
- Naval Facilities Engineering Command
- Naval Sea Systems Command
- Naval Supply Systems Command

As a Photographer's Mate, the Naval Supply Systems Command (NAVSUPSYSCOM) and the Naval Air Systems Command (NAVAIRSYSCOM) are of particular interest to you. These two commands manage the inventories of the types of supplies you use the most. Navy inventory managers are responsible for assigned groups or categories of items of supply. Navy inventory managers include the systems commands, and also project managers, bureaus, offices, and inventory control points (ICPs) under the command of NAVSUPSYSCOM.

The Naval Air Systems Command is the inventory manager for audiovisual equipment, therefore, NAVAIRSYSCOM is of interest to you. Although an inventory manager is responsible for keeping adequate amounts of supplies on hand, these commands can't keep all the stuff in their backyards in Washington. To make supplies available to the fleet, they must be stocked at locations near where the fleet is.

STOCK POINTS

Stock points consist of naval supply centers (NSCs), naval supply depots (NSDs), and industrial naval air stations (INASs).

The mission of these activities is to furnish supply support to fleet units, shore activities, transient ships, and overseas bases. They do this by procuring, receiving, storing, issuing, and

shipping or making other distribution of Navy, Defense Logistics Agency (DLA), and General Services Administration (GSA) cognizance material. The Defense Logistics Agency manages supply items in common use by all military services. The following activities are stock points for the Navy Supply System:

NSC Charleston	NSD Yokosuka
NSC Norfolk	NAS Alameda
NSC Oakland	MCAS Cherry Point
NSC Pearl Harbor	NAS Jacksonville
NSC Puget Sound	NAS Norfolk
NSC San Diego	NAS North Island
NSD Guam	NAS Pensacola
NSD Subic Bay	

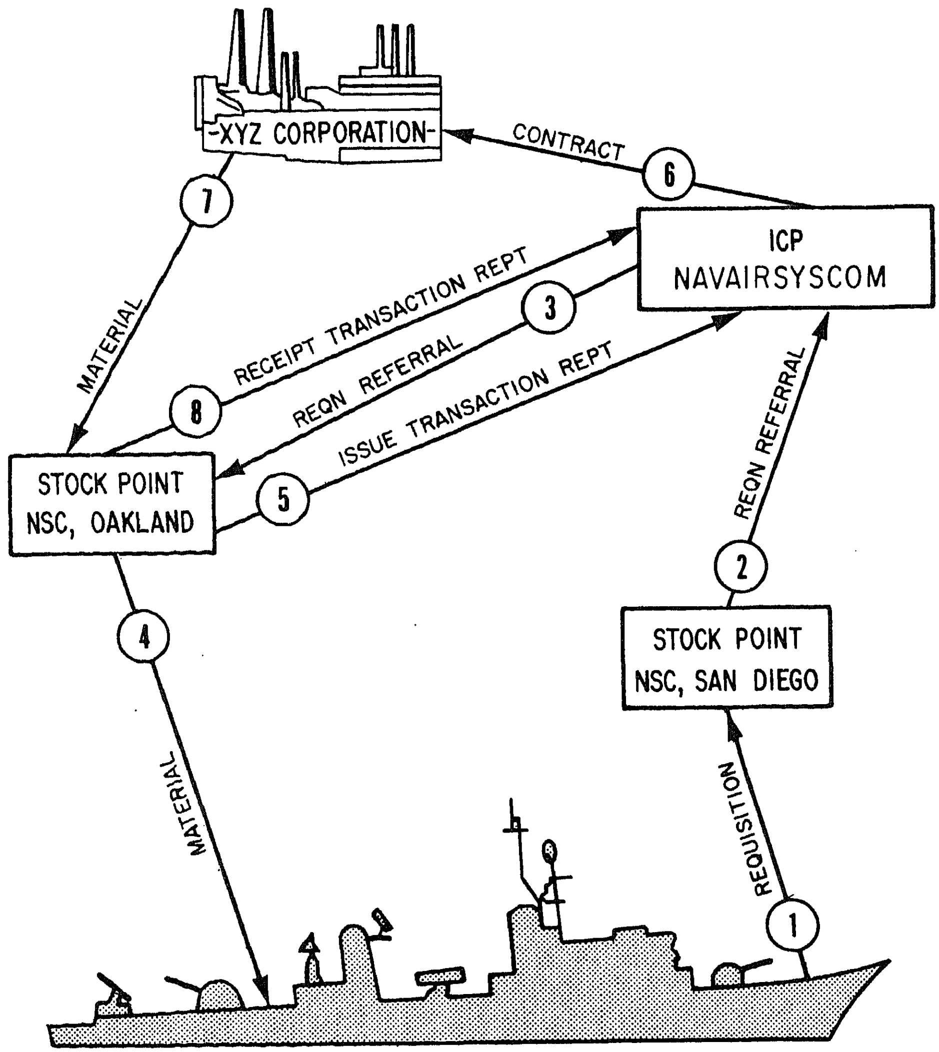
Let's see how the inventory managers and stock points work to fill a supply order:

1. *USS Chance submits a requisition to NSC San Diego for a cognizance 2W item of equipment.*

2. *After researching their records and determining that the item is not in stock, NSC San Diego refers the requisition to NAVAIRSYSCOM.*

3. *NAVAIRSYSCOM after researching their master records and determining that the requested item is in stock at NSC Oakland refers the requisition to NSC Oakland.*

4. *NSC Oakland issues the item to USS Chance.*



5. *NSC Oakland makes an issue transaction report to NAVAIRSYSCOM.*

6. *NAVAIRSYSCOM after applying the issue reports to its master record ascertains that NSC Oakland's stock of the item is below the required level and issues a contract to the XYZ Corporation to replenish NSC Oakland's stock.*

7. *The XYZ Corporation ships the material to NSC Oakland.*

8. *NSC Oakland makes a receipt transaction report to NAVAIRSYSCOM.*

General Services Administration

The General Services Administration (GSA), though not a part of the Department of Defense, does furnish some materials and services to the Armed Forces. It is responsible for supporting all Federal agencies.

GSA maintains stock points at several locations throughout the country. It also has open end contracts with major suppliers for such items as typewriters, adding machines, and calculators. A good portion of the Navy's administrative supplies and equipment are procured from this source.

The GSA makes contracts with many manufacturers to buy at an agreed price. Nearly all audiovisual materials used by the Navy are on "GSA Schedule," as it is called. This means that a local store, carrying material you need, *may* sell it to you at the established GSA price. However, material which is Navy stocked must be ordered from the Navy Supply System. Prices vary between the two systems; sometimes you will pay more when ordering from Navy stock than you would pay through the GSA Schedule. The GSA "Government prices" are generally 20 percent or more below the retail selling price. However, you must "buy Navy" first.

SUPPLY CATALOGS

There are over four million types of supply items in the Department of Defense Supply System. The Navy Supply System alone stocks over one million items. So that you may have access to the entire resources of the Government, a common language has been developed—the Federal Catalog System.

FEDERAL CATALOG SYSTEM

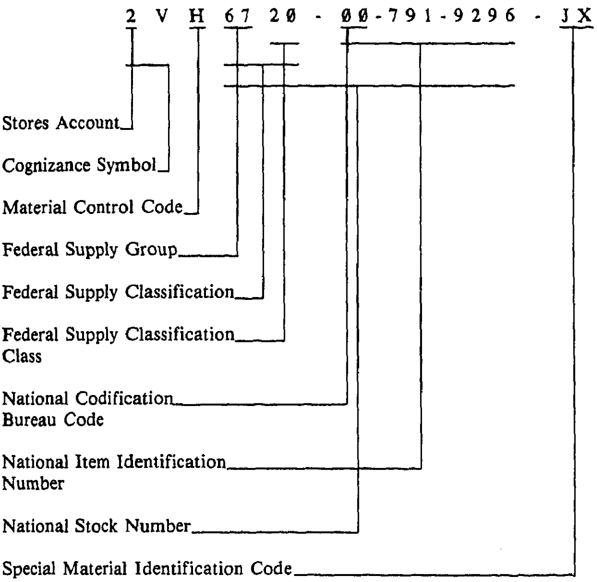
The Defense Logistics Agency (DLA) administers the Federal Catalog System which encompasses all items carried by the Department of Defense and the civil agencies of the Federal Government. The identification of an item in this catalog system is used for all supply functions related to the item from purchase to final disposal. The identification of an item in the Federal Catalog System begins with giving it a Federal Supply Classification number.

Federal Supply Classification System

Each item is classified in one, and only one, four-digit Federal Supply Classification (FSC) number. The first two digits denote the group or major division of commodities; the last two digits are the class or subdivision of commodities within a group. As presently established, the FSC has 90 groups (some currently unassigned). These stock groups cover rather broad categories of material. The second two numbers, designating the class within the group, allow more specific identification. Class numbers may identify the commodities in accordance with their physical or performance characteristics, or may be based on the fact that the items in the class are usually requisitioned or issued together. Below is an example of how the classes are used to divide types of material within a stock group, and create the FSC number.

Group	Classes
Group 67 Photographic Equipment	6710—Cameras, Motion Picture
	6720—Cameras, Still Picture
	6730—Projection Equipment
	6740—Photographic Developing and Finishing Equipment
	6750—Photographic Supplies
	6760—Photographic Accessories
	6770—Film, Processed
	6780—Photographic Sets, Kits, and Outfits

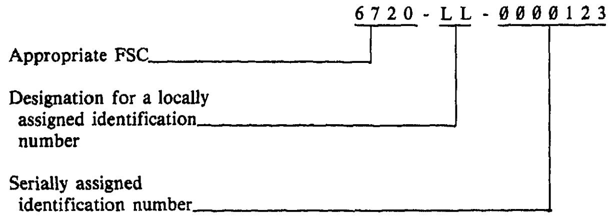
is added, we have the National Stock Number (NSN). The following example illustrates all the elements of the NSN in their proper sequential order:



A very important part of the NSN is made up of the nine digits that comprise the National Codification Bureau (NCB) code and the National Item Identification Number (NIIN). These numbers identify supply items used by DOD. They are used independently to identify items, and most supply catalogs you use are arranged in NIIN order.

NAVY ITEM CONTROL NUMBERS.— Items of material that are not included in the Federal Catalog System, but which are stocked or monitored in the Navy Supply System, are identified by Navy Item Control Numbers (NICNs). NICNs are 13-character item identification numbers which are assigned by Navy inventory managers for permanent or temporary control of selected non-NSN items.

LOCAL ITEM CONTROL NUMBER.— Local item control numbers may be assigned to stocked consumable items such as special developers and camera accessories, etc., which are not otherwise identified. A local item number



Locally assigned item control numbers are authorized for local use only (i.e., for shipboard stock records, bin tags, issue documents, etc.). They are not used in requisitions since such item identification numbers would be meaningless to the supply source.

IDENTIFICATION

By now you can see that the key to getting material from "supply" is to break the code—to get the National Stock Number for the item. But how?

There are two simple ways to do it, as long as they work. The first is to make sure that all your supplies are identified by their numbers—label the bins, put identification tags on the items, and include the numbers on your inventory list. Then, when you start to run short, you have the number right at hand. Most supply POs use this as the basic method, and keep careful records of their stock items. Occasionally you need something new; not a replacement. Then the second method is used. This method is used basically to keep on the good side of your local supply department, so you can get their expert help.

The storekeepers know the system, and can help you quite a bit. However, they do not know your equipment and supplies, so you will possibly have to locate in the catalogs the specific item you want.

One secret of keeping the storekeepers helpful is to not blame them whenever something goes wrong. Enough of this and they will close down for inventory whenever they see you coming. The supply system is very complete and highly automated. Most foul-ups occur because the

requisition contained an error. The people and machines in the system assume you knew what you were doing when you filled it out. If you were off one digit in the stock number you may receive an airplane engine instead of a typewriter, so always be careful.

If you use the wrong NSN to requisition material, you will probably receive stock that you cannot use and certainly not the material desired. Not only will the unit have spent its money uselessly, but stock will have been withdrawn from the supply system that may be urgently needed by another ship or station. There is also the additional delay of waiting for the correct material to be reordered and received.

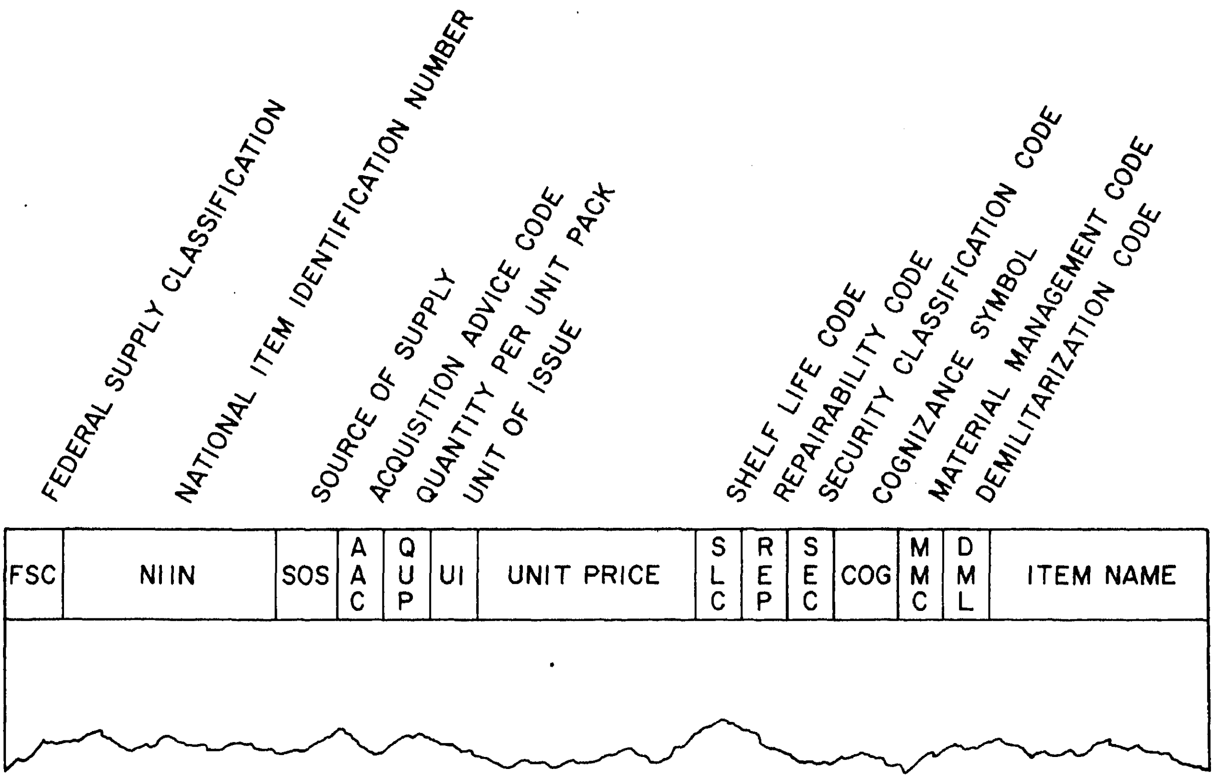
Even when you are replenishing supplies it is a good idea to check the current stock numbers. Normally, if a supply item becomes obsolete, the supply system will automatically fill your order with the current item which replaced it. However, there are times when the substitute item is very different or other uncertainty exists as to what you really want. Then your requisition will be returned, and you have wasted time.

A number of catalogs and lists are available for your use in locating the current ordering information. If you are ordering replacement supplies or equipping an activity, you will use the *Management List-Navy*, the *Afloat Shopping Guide*, your activity's allowance lists, the *DOD Consolidated Federal Supply Catalog*, the *Photographic Equipment List*, the *Navy Stock List*, and the *GSA Catalog*. If you have to order repair parts, the Manufacturers' Manuals, the Illustrated Parts Breakdown, and the *Consolidated Master Cross-Reference List* (C-MCRL) or (CRL) allow you to trace the part number given by the manufacturer and locate the corresponding NSN. For ordering publications and keeping your technical and administrative library up to date, you use the *Navy Stock List of Publications and Forms*. Let's see how you use these and other references.

MANAGEMENT LIST-NAVY

You will find the *Management List-Navy* (ML-N) very helpful for preparing requisitions. It lists stock items in NIIN sequence and gives stock numbers, units of issue, unit prices, shelf-life codes, and other pertinent information on items which the Navy orders. It contains a record of deleted and superseded items with appropriate phrases to indicate disposition action and what item has replaced the deleted item.

A sample page of the ML-N is shown here.



AFLOAT SHOPPING GUIDE

The *Afloat Shopping Guide* (ASG) is one of your most frequently used identification tools. It is designed to assist you in identifying an NSN for those items of supply not related to a part/reference number. Descriptions and illustrations may be used to determine substitutions and applicable NSNs in the general hardware area.

The ASG is comprised of two volumes containing descriptive data and illustrations accompanied by indexes of groups/classes included; alphabetic and NIIN listing of included items. The NIIN index also indicates the availability of an item from the Mobile Logistics Support Forces. A page from the ASG is shown here.

DOD CONSOLIDATED FEDERAL SUPPLY CATALOG 6700IL

The *DOD Consolidated Federal Supply Catalog* 6700IL identifies FSC Class 6700 materials including FSC 6750 photographic supplies stocked by the Defense General Supply Center.

PHOTOGRAPHIC EQUIPMENT LIST

The *Photographic Equipment List* (PEL) lists supporting repair parts for repairable photographic equipment. All active PELs are listed in Section C-0001 of the *List of Navy Publications,* issued by the Aviation Supply Office (ASO).

NAVY STOCK LIST

The part of the *Navy Stock List* that is used most by Photographer's Mates is the *Photographic Major Assemblies and Related Components and Equipment,* ASO E-6789.

This publication lists standard stock photographic materials under the control of the Aviation Supply Office and NAVAIRSYSCOM. It describes and identifies the equipment and materials listed. The primary equipments are listed alphabetically by name. Each primary equipment is followed first by its components, and second, when applicable, by related equipments and their components. Within name, arrangement is alphanumerical by type designation, or by physical characteristics if no type designation exists.

ALLOWANCE LISTS

Allowance lists specify the kind and quantity of equipment, equipage, repair parts, and supporting materials that a unit should have. Of particular interest to Navy photographers are the *Allowance Lists,* NAVAIR 00-35QP series, published by ASO under the direction of NAVAIRSYSCOM, containing authorized allowances of photographic equipment and materials.

It is the policy of NAVAIRSYSCOM to make available to each Navy AV activity the authorized equipment and repair parts necessary to ensure operational readiness. Allowance list requirements are not mandatory and deviations can be approved.

GSA CATALOG

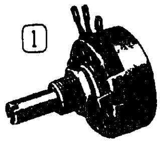
The General Services Administration (GSA) exercises inventory control over and is responsible for cataloging nonmilitary items in general use by both military and civil agencies of the United States Government. The *GSA Supply Catalog* is a handy reference in identifying consumable-type material.

It is published in four volumes. Volume 1 contains an alphabetical index. Volume 2 contains an NSN index with current prices and other ordering information, and changes to Volume 1. Volume 3 contains descriptions of material, in a format similar to the ASG. Volume 4 is a price list for Volume 3.

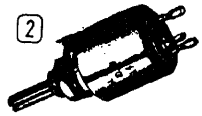
NAVY STOCK LIST OF PUBLICATIONS AND FORMS

The *Navy Stock List of Publications and Forms,* NAVSUP P-2002, commonly referred to

1



2



Specification Data–MIL-R-94

TYPE	TAPER	WATTS	BUSHING SIZE	SHAFT DIA.	BODY DIM.	FIG
RV2	A	1	3/8-32	1/4	.64 x .42	1
RV2	C	1/2	3/8-32	1/4	.64 x .42	1
RV4	A	2	3/8-32	1/4	.90 x .45	1
RV4	C, F	1	3/8-32	1/4	.90 x .45	1
RV5	A	1/2	1/4-32	1/8	.75 x .37	1
RV6	A	1/2	1/4-32	1/8	.50 x .37	2
RV6	C, F	1/4	1/4-32	1/8	.50 x .37	2

1 WATT

Locking bushing, 5/8 in. lg shaft.

	Ohms	Mil Type RV2LAYSA
00-815-5498	10K	103A

Standard bushing, 7/8 in. lg shaft.

	Ohms	Mil Type RV2N
00-835-8870	1.5K	AYSD152A
00-577-6803	10K	AYSD103A
00-964-6059*	10K	BYSD103A
00-853-0793	100K	AYSD104A

*With SPST switch.

2 WATT

Locking bushing, 5/8 in. lg shaft.

	Ohms	Mil Type RV4LAYSA
00-681-8688	50	500A
00-503-5984	100	101A
00-503-6218	250	251A
00-539-4897	500	501A
00-646-5958	1K	102A
00-539-2567	2.5K	252A
00-539-2479	5K	502A
00-518-5595	10K	103A
00-501-7314	25K	253A
00-501-5184	50K	503A
00-665-4992	100K	104A
00-552-2093	250K	254A
00-518-5593	500K	504A
00-518-5609	1MEG	105A
00-552-5487	5MEG	505A

Locking bushing, 7/8 in. lg shaft.

	Ohms	Mil Type RV4LAYSD
00-577-3717	2.5K	252A
00-577-3645	25K	253A
00-556-3042	100K	104A
00-023-7931	1MEG	105A

Standard bushing, 1/2 in. lg shaft.

	Ohms	Mil Type RV4NAYSB
00-542-8046	1K	102A
00-646-5957	10K	103A
00-646-5981	25K	253A
00-643-6284	50K	503A
00-542-8048	100K	104A
00-542-8051	1MEG	105A

Standard bushing, 7/8 in. lg shaft.

	Ohms	Mil Type RV4NAYSD
00-556-3041	100	101A
00-552-2859	500	501A
00-552-5478	1K	102A
00-577-9976*	1K	
00-539-5013	2.5K	252A
00-643-5626	5K	502A
00-578-4471	7.5K	752A
00-556-3350	10K	103A
00-552-5479	15K	153A
00-539-1559	25K	253A
00-539-4900	50K	503A
00-644-6693	100K	104A
00-552-5476	250K	254A
00-893-9499	500K	504A
00-501-7307	1.5MEG	155A
00-655-3312	2MEG	205A

*With SPST switch, MIL Spec type RV4NBYSD102A.

Standard bushing, 1-1/4 in. lg shaft.

	Ohms	Mil Type RV4NAYSG
00-811-1750	2.5K	252A

Standard bushing, 2-1/2 in. lg shaft.

	Ohms	Mil Type RV4NAYSK
00-539-4999	100	101A
00-539-2568	250	251A
00-557-4637	500	501A
00-500-7588	1K	102A
00-542-8724	2.5K	252A
00-666-1036	5K	502A
00-665-5095	10K	103A
00-581-2846*	10K	
00-500-7879	25K	253A
00-542-8744	50K	503A
00-339-4576	100K	104A
00-539-4578	250K	254A
00-539-4998	500K	504A
00-552-2254	1MEG	105A

*With SPST switch, MIL Spec type RV4NBYSK103A

C TAPER

1/4 WATT

Standard bushing, 7/8 in. lg shaft.

	Ohms	Mil Type RV5NAYSD
00-802-7951	5K	502C

	Ohms	Mil Type RV6NAYSD
00-851-5648	5K	502C
00-954-4038	10K	103C

1 WATT

Locking bushing, 7/8 in. lg shaft.

	Ohms	Mil Type RV4LAYSA
00-578-9051	1MEG	105C

Standard bushing, 7/8 in. lg shaft.

	Ohms	Mil Type RV4NAYSD
00-681-6172	500	501C
00-552-3480	10K	103C

Standard bushing, 7/8 in. lg. (Shaft and panel sealed.)

	Ohms	Mil Type RV4SAYSD
00-542-9406	500	501C

Standard bushing, 2-1/2 in. lg shaft.

	Ohms	Mil Type RV4NAYSK
00-553-9970	2.5K	252C
00-578-4134	50K	503C

F TAPER

1/4 WATT

Locking bushing, 5/8 in. lg shaft.

	Ohms	Mil Type RV6LAYSA
00-752-3377	50K	503E

1 WATT

Locking bushing, 5/8 in. lg shaft.

	Ohms	Mil Type RV4LAYSA
00-683-5996	10K	103E

INDUSTRIAL TYPE. A taper. Fully inclosed body with 1/4 in. diameter slotted shaft and mounted by a 3/8 - 32 thread bushing.

Single section

2-1/4 Watt at 70 deg C, body dimension. 11/16 in. lg x 1-5/32 in. diameter, 1-7/16 in. lg shaft, panel sealed bushing, 3 solder lug terminals.

00-482-4992 350 OHMS 10% tol

3 Sections

2 Watt at 70 deg C, body dimension. 1-29/32 in. lg x 1-5/32 in. diameter, 5/8 in. lg shaft, 9 solder lug terminals.

00-264-7818 2.5 meg, 2.5 meg, 20%, 25K, 10%

as the "I Cog Catalog," consists of three sections:

Section I —Alphabetic/Numeric Listing of Form Numbers, Publications and Hull Numbers; Electronic Model Numbers and Standard Subject Identification Code for Cog 1I Forms.

Section II —Alphabetic Listing of Publications and Forms by Title/ Nomenclature.

Section III—Numeric Listing of Publications and Forms by Stock Number followed by NAVAIRSYSCOM Technical Directives (by type and directive number).

Publications and Forms are sequenced together. Microfiche editions of NAVSUP P-2002 are issued quarterly, each edition reflects all current Cog ØI and 1I Publications and Forms. Section I and Section III reflect information such as Canceled, No Superseding Item, Superseded By, and Replaced By.

The Introduction to *Navy Stock List of Publications and Forms* provides detailed information about the columnar arrangement of the stock list. Additionally, it provides the instructions needed to requisition publications and forms.

LOAD LISTS

Load lists are an inventory of material carried by Mobile Logistics Support Force (MLSF) ships (including tenders and repair ships), or bases to fulfill assigned supply support of fleet units. They, like allowance lists, will help you determine NSNs for material requirements.

MANUFACTURERS' PART NUMBERS

When replacement parts are needed, either to repair equipment or as a spares inventory so repairs can be made when you are deployed, you usually have to start with the number of the part which was assigned by the manufacturer. A knowledge of some of the various methods of identifying an item to a stock number, a stock number to an item, or the part to a usable number other than a stock number may prove to be very helpful.

Normally, the manufacturers of parts affix a part number on each item manufactured. The use of this manufacturer's part number and the knowledge of the part's application normally lead to the positive identification of the part's nomenclature and National Stock Number. The part number can be ascertained to be correct by reference to the appropriate Illustrated Parts Breakdown (IPB), and the National Stock Number may be obtained by reference to the appropriate Consolidated Master Cross-Reference List (C-MCRL). It should be remembered that part numbers may be duplicated by various manufacturers; therefore, the Federal Supply Code for manufacturers must be considered when cross-referencing a part number to the NSN.

Drawing Number

A drawing number consists of letters or numbers, or a combination of letters and numbers, which are assigned to a particular drawing for identification purposes. The activity controlling the drawing (normally the manufacturer) assigns the number in conformance with their drawing numbering system. One drawing may apply to several items; thus, other distinguishing data may be necessary to identify the item on the drawing.

Drawing numbers may be used to identify the microfilm available on some support equipment and kept in many technical libraries. Some large assemblies are illustrated in IPBs but are not broken down sufficiently to show identifying data for their component parts. By obtaining the drawing number of the larger item and cross-referencing it to the applicable microfilm, sufficient identifying information for the component part may be obtained.

Specification Number

Specification numbers are assigned to documents describing the characteristics and the

Government. These specifications are used by purchasing officers to ensure that all the requirements for the material are met. Specification numbers are particularly useful on some support equipment in trying to procure component parts.

Nameplate

Some equipments have nameplates attached which provide such information as the manufacturer's name or code, make or model number, serial number, size, voltage, phase, NSN, etc. This is particularly helpful when requesting material not subject to the Federal Catalog System.

Marking and Measurements

Special coded markings (other than part numbers) and measurements often aid in the identification of some materials.

MANUFACTURERS' INSTRUCTION BOOKS

Most AV equipment purchased by the Navy is covered by instruction books or technical manuals published by the manufacturers. You will use these books occasionally as an aid to material identification since they often include parts lists and detailed drawings and specifications.

ILLUSTRATED PARTS BREAKDOWN

Illustrated Parts Breakdown (IPB) publications are an important source of information necessary to order specific support equipment parts. Properly used, they will provide reference information necessary to identify a part number to the specific model of equipment and in some cases provide interchangeability data that can be utilized when the prime item requested is not in stock.

An Illustrated Parts Breakdown is prepared by the manufacturer for most major items of AV equipment and accessories. The IPB is designed to enable supply and maintenance personnel to identify and order replacement parts for equipment. Procurable assemblies and detail parts are illustrated and listed in such a manner as to and their component parts. The items are arranged continuously in assembly breakdown order with the illustrations placed as near as possible to their appropriate listing.

Although slight variations in format exist among the various IPBs, each usually includes the following major sections:

The INTRODUCTION includes general information about the equipment, contents of the publication, and instructions for its use. The introduction should be referred to prior to using an unfamiliar IPB.

The GROUP ASSEMBLY PARTS LIST consists of a breakdown of the complete unit into major components, systems, installations, assemblies, and detail parts. Generally, parts are indexed in disassembly order. In some instances, assemblies or installations are shown in assembled form in one figure and the detail parts are illustrated in another figure.

The NUMERICAL INDEX lists part numbers in alphanumerical order, and each part number is cross-referenced to the figure and index number where it is illustrated. This section also shows the total quantity of each part used in the equipment, material source code, and National Stock Number when applicable.

The REFERENCE DESIGNATION INDEX lists, in alphanumerical order, reference designators (example: B1, J1, K7, etc.) symbols on drawings and wiring diagrams. The index also lists part numbers and index numbers of where the parts are located in the IPB.

CONSOLIDATED MASTER CROSS-REFERENCE LIST

The Consolidated Master Cross-Reference List CRL is designed to provide a cross-reference from a reference number such as a manufacturer's part number, a drawing number, a design control number, etc., to its assigned National Stock Number (NSN), (Part I), and from NSN to reference number, (Part II), to assist in identifying items in the supply system. It includes items of supply which are utilized by all services; therefore, many NSNs will be identified in the CRL which are not listed in the Navy Management List.

The format of Part I of the CRL is shown here. The information presented in each column is as follows:

COLUMN TITLE	DATA PRINTED
Reference No.	A number, other than an activity stock number, used to identify an item of production.
Mfr. Code	The applicable manufacturer's assigned five-digit code as listed in the Cataloging Handbook H4-2.
RNVC (Reference Number Variation Code)	A code indicating whether the reference number is item-identifying or requires additional data to correctly identify the item of supply.
National Stock No.	The NSN assigned to the reference number.

The Reference Number Variation Code (RNVC) column indicates, by use of the numbers 1, 2, 3, and 9, those items that require supplementary data to fully identify them. These codes are as follows:

Code 1—Nonidentifying—The reference number does not completely identify the item. When cited, it must be accompanied by additional descriptive data such as color, length, rating, etc.

Code 2—Identifying —The reference number in company with the Federal Supply Code for Manufacturers (FSCM) completely and uniquely identifies the item of supply. Code 2 items may also have nonidentifying reference numbers.

Code 3 —The reference number is a vendor's number on a Source Control Item.

Code 9 —This code is used to indicate (1) reference number is for information only, (2) reference number or specification is obsolete or superseded.

Part II of the CRL presents the same data in NIIN sequence.

OBTAINING MATERIAL

Once you have found the stock numbers, you are ready to requisition your supplies. Most material is obtained by requisition, but purchase is used to procure nonstandard material and to meet emergency requirements. The simplest form of a requisition is merely a request for material made out on the appropriate Navy form and drawn at a naval supply activity. In the event that material is required to be obtained by open purchase to fill specialized needs, this also is usually handled by the local supply division or activity.

Two requisitions forms are used to order supplies and services: the DD Form 1348 and DD Form 1149. Under certain circumstances, requisitions may be submitted by message or letter. Normally, requisitions are submitted on the DOD Single Line Item Requisition System Document, DD Form 1348. However, the DD Form 1149 may be used for certain material or services.

In the preparation and use of the DD Form 1348, you must be familiar with certain terms, and the systems that govern the form's use—Military Standard Requisitioning and Issue Procedures (MILSTRIP), and Uniform Material Movement and Issue Priority System (UMMIPS).

MILSTRIP

The Military Standard Requisitioning and Issue Procedures (MILSTRIP) system provides a common language for requesting and supplying material within and among the Army, Navy, Air Force, Marine Corps, and the General Services Administration (GSA), and it provides a requisition document (the DD Form 1348) that can be processed by electronic accounting machine/automatic data processing (EAM/ADP) equipment and contains all information necessary to issue, ship, and account for the requested material.

Some of the common terms in the "common language" of MILSTRIP are:

BACKORDER—A requisition that cannot be filled by the supply activity from current stock and is being held until additional stock is received, at which time the issue will be made.

MATERIAL OBLIGATION VALIDATION (MOV) REQUEST—A request from a supply source to a requisitioner for a comparison of requisitions held on backorder by the supply source with those carried as outstanding by the requisitioner.

REFERENCE NO.	MFR CODE	RN VC	NATIONAL STOCK NO.
55599	62983	2	4320-00-057-0782
556	24161	2	3030-00-269-9669
556-012-001	16665	2	5950-00-237-7237
556-1137	46859	2	5841-00-323-0747
556-1182	46859	2	5365-00-323-0749
556-2332	46859	2	5305-00-433-9273
556-35-1246FW160P 2	01351	2	3020-00-967-4607
556-3541	46859	2	5365-00-514-0363
556-3541-1	46859	2	5365-00-200-5226
556-3936	46859	2	3020-00-093-6898
556-5505	46859	2	3020-00-036-8447
556-6539	46859	2	5365-00-546-2346
556-8804	46859	2	3110-00-198-1007
556DB20W035B55	00853	2	5910-00-490-7941
556D008G16	79500	2	5977-00-983-1330
556D008G18	79500	2	5977-00-495-6757
556DGAX2-20H	30760	2	4320-00-595-0790
5560	72149	2	5950-00-647-5926
5560-15	79136	2	5365-00-916-4521
55600	43334	2	3110-00-542-1673
55600XR1B	43334	2	3110-00-542-1673
556001-548	12436	2	5935-00-054-4244
556002-129	16665	2	5935-00-451-3179
556012-022	16665	2	5950-00-826-5827

Columns of the Consolidated Master Cross-Reference List, Part 1.

MATERIAL OBLIGATION VALIDATION (MOV) RESPONSE—Reply by a requisitioner to a MOV request advising the supplier to: Hold a backorder until supplied; Cancel a backorder; Reduce the quantity.

CANCELLATION—A total or partial discontinuance of supply action requested by the requisitioner and confirmed by the supplier.

CHARGEABLE ACTIVITY—The activity for which the expenditure represents a cost of operation regardless of the funds used.

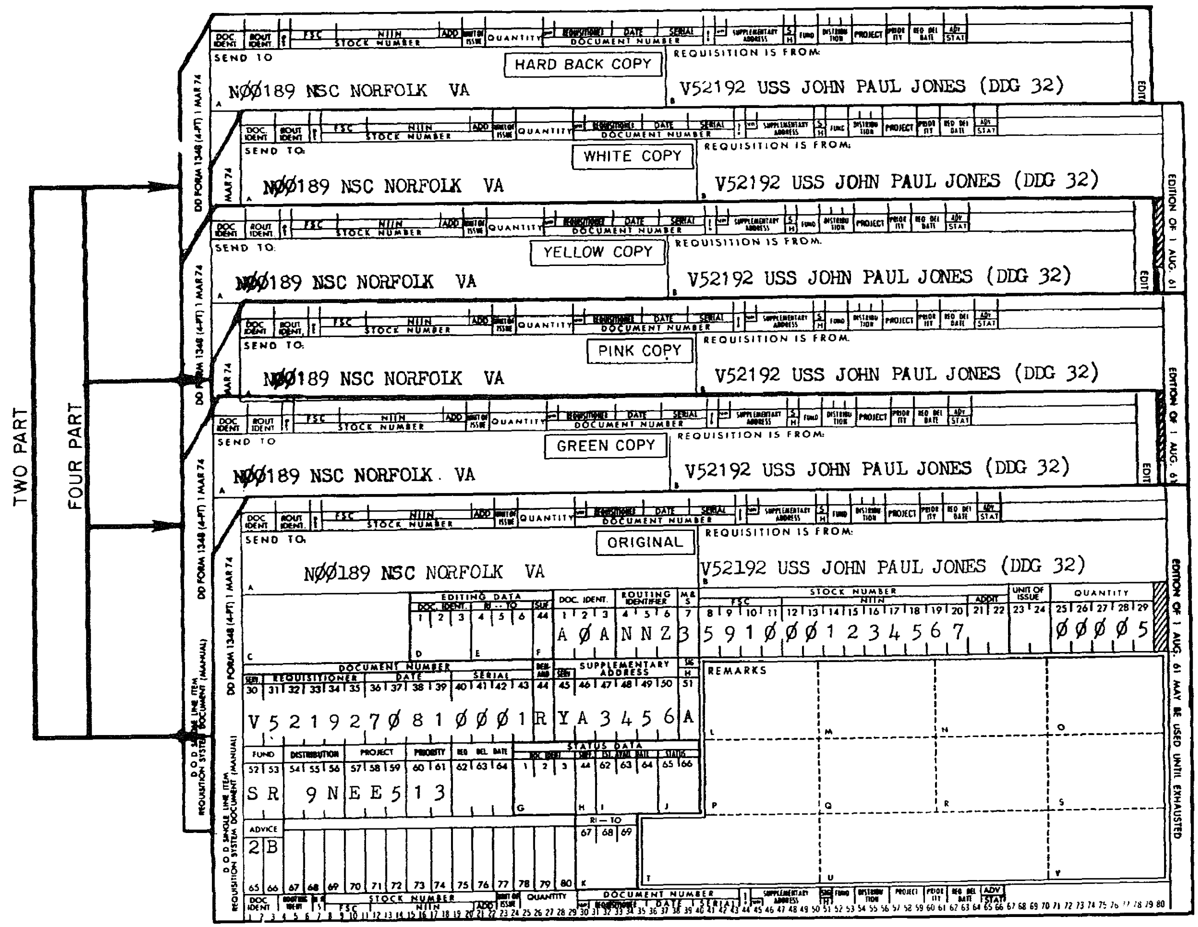
EXCEPTION STATUS—Any supply action other than issue of material in the quantity requested.

FOLLOWUP—An inquiry by the requisitioner to the last known holder of a requisition as to the action taken on that requisition.

FOLLOWUP REPLY—Current status by the holder of the requisition in response to a followup.

FORCE/ACTIVITY DESIGNATOR (F/AD)—A Roman numeral designator established by each military service or the Joint Chiefs of Staff which relates to the military mission of the force or activity.

OUTSTANDING REQUISITION—A requisition for which all requested material has not been received.



DOD Single Line Item Requisition System Document (Manual), (2-, 4-, and 6-part form), DD Form 1348.

STANDARD DELIVERY DATE (SDD)—The standard delivery date is based on the priority designator in the requisition, and is the latest date by which the supply system normally is expected to make delivery of material to the requisitioner.

REQUISITIONER—Any Navy activity, afloat or ashore with a unit identification code (UIC) assigned to the *NAVCOMPT Manual,* Volume 2, Chapter 5, requisitioning material from a supply source.

SHIPMENT STATUS—Positive advice of shipment indicating date and mode of shipment, including transportation control number or bill of lading number when applicable.

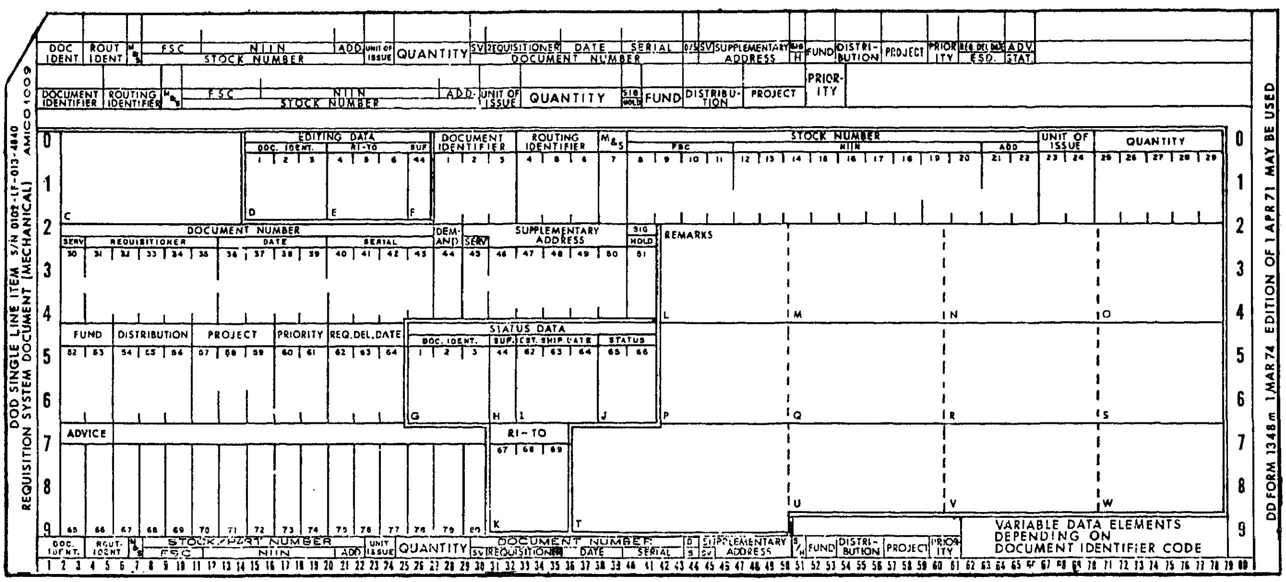
STATUS CODES—Codes used by supply sources to furnish information on the status of requisitions to the requisitioner or consignee.

100% SUPPLY STATUS—Any positive or negative supply distribution decision or action at any level; e.g., any action by the supplier, including issue of material in exact quantity requested.

The DD Form 1348, DOD Single Line Item Requisition System Document is available as 2-part, 4-part, or 6-part forms for manual use or a single card form for mechanized use. All copies of the manual forms are identical except for data blocks T and U. These blocks are blank on the original, but the copies are printed to provide a place to show the unit and total price. The mechanized form is basically the same as the manual, except that data blocks A and B are omitted.

You can readily see the extensive use of codes in MILSTRIP requisitioning. This is necessary because only 80 alphabetic and/or numeric characters (letters and numbers) can be placed on the card (this does not include the activity names shown in data blocks A and B). It is essential for you to select the correct code to convey the proper information to the supplier. The correct codes are just as important on a requisition as the correct NSN.

Make out your DD Form 1348 with a typewriter or ballpoint pen. Do not use a pencil, because pencil marks can smudge and cause errors when the requisition is processed through mark-sensing equipment. In preparing requisitions it is not necessary to space the entries within the "tic" marks printed on the forms, but you must get each entry inside the proper data blocks. To eliminate any possible confusion between the numeric zero and an alphabetic "O," the communication zero (Ø) is used on MILSTRIP requisitions.



DD Form 1348m (Mechanical).

Form 1149.

UMMIPS

The Uniform Material Movement and Issue Priority System (UMMIPS) is a vital and integral part of the MILSTRIP system. MILSTRIP provides forms and procedures for requisitioning material and UMMIPS provides the method of assigning priorities for the issuing and movement of material. UMMIPS ensures that material issue requests are processed in accordance with the military IMPORTANCE of the requiring activity and the URGENCY of that activity's needs. In the movement and issue of material it is necessary to provide a common basis to identify the relative importance of completing demands for logistics systems resources, such as transportation, warehousing, introduction of requisitions for processing, and material assets. The relative importance and urgency of logistics requirements is indicated by two-digit issue priority designators.

Force/Activity Designator

A Force/Activity Designator (F/AD) is a Roman numeral (I thru V) which identifies and categorizes a force or activity on the basis of its

Urgency of Need Designator

The Urgency of Need Designator (UND) is an uppercase letter of the alphabet (A, B, or C) selected to indicate the relative urgency of a force or activity's need for a required item of material. Assignment of UNDs is the responsibility of the force or activity requiring the material.

UND	Definition
A	Requirement is immediate. Without the material needed, the activity is unable to perform one or more of its primary missions.
B	Requirement is immediate, or it is known that such requirement will occur in the immediate future. The activity's ability to perform one or more of its primary missions will be impaired until the material is received.
C	Requirement is routine.

F/AD AND UNDs PRIORITY DESIGNATORS					
URGENCY OF NEED DESIGNATOR	F/AD				
	I	II	III	IV	V
	PRIORITY DESIGNATOR				
A (UNABLE TO PERFORM)	01	02	03	07	08
B (PERFORMANCE IMPAIRED)	04	05	06	09	10
C (ROUTINE)	11	12	13	14	15

Issue Priority Designator

The Issue Priority Designator (IPD) is a two-digit number (Ø1—highest to 15—lowest) determined by using the table of priority designators.

For example, if your ship is assigned an F/AD of III and your requirement is of a routine nature, the priority to be assigned would be 13.

In addition to providing standardized criteria for assigning priorities, UMMIPS provides acceptable maximum processing times for use by supply activities in furnishing material. Processing time standards and additional codes used in MILSTRIP and UMMIPS are included in NAVSUP P-485.

PROCUREMENT PROCEDURES

There are a number of sources of information for filling out the DD Form 1348, but to ensure you have access to those procedures, we have included the basic process in Appendix III of this text.

Several publications are available either in your unit or your servicing supply department to give specific procedures and notices regarding the supply system.

Naval Supply Systems Command Publication 437

The NAVSUP P-437 promulgates policy and procedures relative to the Military Standard Requisitioning and Issue Procedure and the Military Standard Transaction Reporting and Accounting Procedures (MILSTRIP/MILSTRAP). This publication covers MILSTRIP/MILSTRAP relative to supply system management, requisitioning ashore, inventory control, financial matters, material movement, priorities, and evaluation procedures. This publication provides forms, formats, codes, and serves as a comprehensive ready reference for those involved in the preparation and/or processing of MILSTRIP documents.

NAVSUP P-437 is not distributed afloat. All afloat MILSTRIP/MILSTRAP are incorporated into the NAVSUP P-485.

MILSTRIP/MILSTRAP

Desk Guide (NAVSUP P-409)

Since NAVSUP P-437 is a comprehensive publication, filling three 2-inch binders, the MILSTRIP/MILSTRAP Desk Guide, NAVSUP P-409, is published to serve as a handy reference for originating and processing MILSTRIP and MILSTRAP documents. This small booklet contains those common definitions, coding structures, and abbreviated code definitions used on a day-to-day basis.

Fleet Use of MILSTRIP (NAVSUP P-410)

NAVSUP P-410 serves the same purpose as the Desk Guide (NAVSUP P-409) and is for use by fleet personnel. In addition, it is designed to be used for indoctrination and training of fleet personnel in MILSTRIP.

DD Form 1149

The Requisition and Invoice/Shipping Document, DD Form 1149, is used as the procurement document for the items excluded from MILSTRIP. These items are listed in the NAVSUP P-485.

A requisition on the DD Form 1149 is limited to a single page and must be prepared with a typewriter or ballpoint pen.

The requisition number and priority are assigned in the same manner as for the MILSTRIP requisition. However, when more than one item is being ordered, only the UIC and Julian date are shown in data block 6. A separate

SHIPPING CONTAINER TALLY → 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

REQUISITION AND INVOICE/SHIPPING DOCUMENT

SHEET NO. 1	NO. OF SHEETS 1	5 REQUISITION DATE 15 OCT 197–	6 REQUISITION NUMBER R52192-4288	

1. FROM: R52192 USS JOHN PAUL JONES (DDG 32)

2. TO: NØØ244 NSC SAN DIEGO, CA

3. SHIP TO - MARK FOR:
SUPPLY OFFICER
USS JOHN PAUL JONES (DDG 32)
PIER 2, NAVSTA, SAN DIEGO, CA.

7 DATE MATERIAL REQUIRED: 30 OCT 197–

8 PRIORITY: 13

9 AUTHORITY OR PURPOSE:

10. SIGNATURE: I.L. GARNER, LT, SC, USN

11a. VOUCHER NUMBER AND DATE:

b

12 DATE SHIPPED:

13 MODE OF SHIPMENT:

14 BILL OF LADING NUMBER:

15 AIR MOVEMENT DESIGNATOR OR PORT REFERENCE NO:

4. APPROPRIATION AND SUBHEAD	OBJ. CL.	BUR CONT. NO	SUBAL-LOT	AUTHORIZATION ACCT'G ACTIVITY	TRANS. TYPE	PROPERTY ACCT'G ACTIVITY	COUN-TRY	COST CODE	AMOUNT
FUND CODE NU									

ITEM NO (a)	FEDERAL STOCK NUMBER, DESCRIPTION, AND CODING OF MATERIAL AND/OR SERVICES (b)	UNIT OF ISSUE (c)	QUANTITY REQUESTED (d)	SUPPLY ACTION (e)	TYPE CON-TAINER (f)	CON-TAINER NOS (g)	UNIT PRICE (h)	TOTAL COST (i)
	SERVICES AND MATERIAL FOR REPAIR OF:							
3ØØ1	MARCHANT CALCULATORS, Ser. Nos. 441067, 441255	JOB	1					
3ØØ2	FRIDEN ADDING MACHINE, Ser. No. 56432	JOB	1					
3ØØ3	IBM ELECTRIC TYPEWRITERS, Ser. Nos. 14-367421, 15-667441	JOB	1					
3ØØ4	REMINGTON ELECTRIC TYPEWRITER, Ser. No. 336601	JOB	1					

16 TRANSPORTATION VIA MATS OR MSTS CHARGEABLE TO

17 SPECIAL HANDLING

18 RECAPITULATION OF SHIPMENT	TOTAL CONTAINER	TYPE CONTAINER	DESCRIPTION	TOTAL WEIGHT	TOTAL CUBE	19. RECEIPT	DATE	BY	
ISSUED BY						CONTAINERS RECEIVED EXCEPT AS NOTED	DATE	BY	SHEET TOTAL
CHECKED BY						QUANTITIES RECEIVED EXCEPT AS NOTED	DATE	BY	GRAND TOTAL
PACKED BY			← TOTAL →			POSTED	DATE	BY	20 RECEIVER'S VOUCHER NO

DD FORM 1 MAR 59 1149 (9 - PT) 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

REPLACES EDITION OF 1 MAY 58 WHICH MAY BE USED   S/N 0102-LF-011-1801   **ORIGINAL**

Requisition and Invoice/Shipping Document, DD Form 1149 (Multiple Requests).

serial number is assigned to each item on the requisition.

SPECIAL REQUISITIONING INFORMATION

Thus far, you have learned how requisitions are prepared and submitted for routine requirements. Not all requisitions, however, are routine. For some, special handling or additional information is required.

SERVMART

SERVMARTS are convenient sources of material that permit the use of a single money value only (MVO) requisition to procure several stock items. SERVMARTS are located at most major naval bases and are arranged in a supermarket concept.

When it is appropriate to obtain material from a SERVMART, an MVO DD Form 1348 is prepared. Each of the following categories of material is listed on a separate DD Form 1348 when SERVMART shopping lists (SSLs) are used:

- Consumable items
- Repair parts
- Equipage

To aid you in preparing requisitions, each SERVMART prepares shopping guides that list items stocked and distributes these guides to ships and activities in the area.

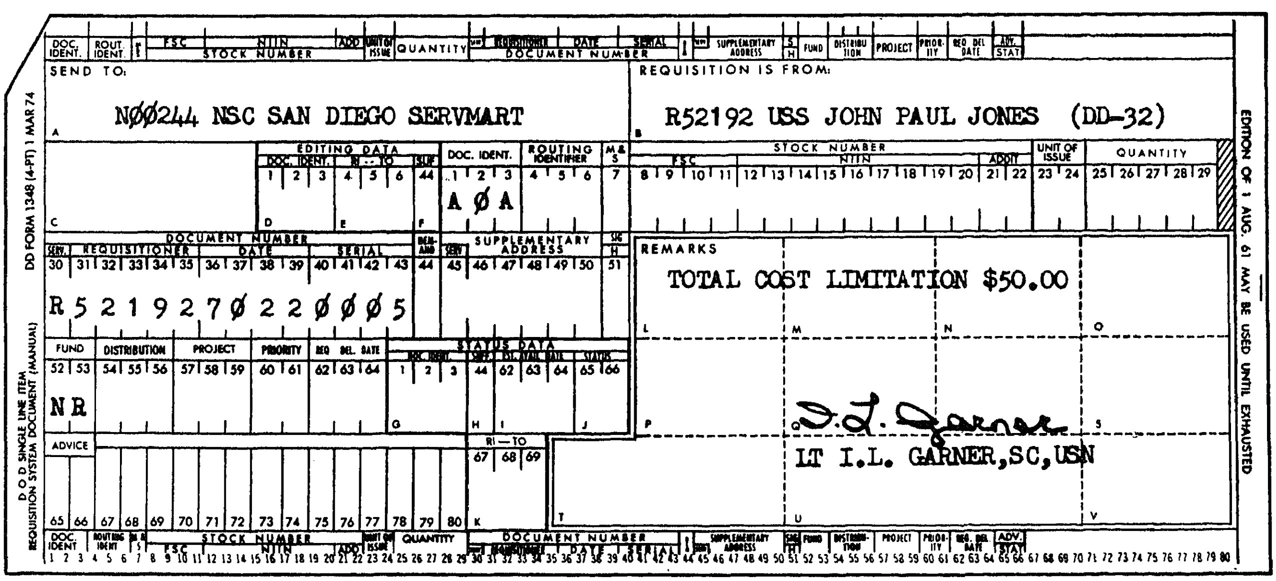
Upon receipt of an internal request, a DD Form 1348 is prepared to cover the money value, and the original is given to the person authorized on the form to pick up the material.

Transfer From Other Ships and Activities

Emergency requirements may be obtained from ships other than supply ships and tenders if the material is available and can be spared. The request may be made on a DD Form 1348 or by message and should contain the same information as a requisition to a supply activity except for the routing identifier which is left blank. If the requested material is not available for issue, the requisition is returned to the requisitioner since ships do not hold requisitions on backorder for later issue.

Forms and Publications

Forms are requisitioned on DD Form 1348 in the same manner as any other consumable material.


DD FORM 1348 (4-PT) 1 MAR 74
D O D SINGLE LINE ITEM REQUISITION SYSTEM DOCUMENT (MANUAL)
EDITION OF 1 AUG. 61 MAY BE USED UNTIL EXHAUSTED

SEND TO: N00244 NSC SAN DIEGO SERVMART

REQUISITION IS FROM: R52192 USS JOHN PAUL JONES (DD-32)

DOC. IDENT.: A0A

DOCUMENT NUMBER: R52192 7022 0005

FUND: NR

REMARKS: TOTAL COST LIMITATION $50.00

I.L. Garner

LT I.L. GARNER,SC,USN

Publications (identified by cognizance symbol Ø1) are not carried in a stores account and are issued without charge.

Special requisitioning instructions, approval requirements, and restrictions are indicated in the Requisition Restriction (RR) column of the *Navy Stock List of Forms and Publications*.

NAVSUP Form 1205 is used to order Navy departmental directives. There is no cost for these directives. The form is preaddressed to the Naval Publications and Forms Center and may be placed in a window envelope for mailing after it (including the return address label) has been filled out.

Requisition Followup

When material or status has not been received by the standard delivery date (SDD) or the required delivery date (RDD), you may submit a followup to determine the status. The standard delivery date is computed by adding the authorized UMMIPS delivery time to the Julian date of your requisition. The followup may be submitted on DD Form 1348 (2-part).

The document identifier AF1 and the routing identifier for the last known holder of the requisition are assigned. The balance of the followup is identical to the original requisition unless part of the material has already been received.

When taking followup action on a requisition for urgently needed material and for which the SDD or RDD is past with no status received, document identifier AT_ may be used instead of AF1. This tells the supply activity that if they have no record of the original requisition to process the followup as a requisition. This could preclude the need for another requisition if response to an AF1 followup should be "no record of your requisition." However, it may also result in duplicate shipment and billing.

Requisition Cancellation

When material, not delivered, is no longer required, you should send a cancellation request to the last known holder of the requisition. It is prepared in the same manner as a followup except that a document identifier in the AC _ series is used. Submission of a cancellation request does not guarantee cancellation of the requisition. If the supply activity has already released or shipped the material, the requisition cannot be canceled. For this reason, you should not consider a requisition canceled until confirmation is received from the supply activity.

Purchase

Purchase actions are normally taken by a shore activity as a result of emergency requirements for supplies or services by purchase on the open market when all of the following conditions exist:

- There is an immediate and urgent requirement for authorized supplies or services.
- The supplies or services are not available at the local supply support activity.
- Time is of the essence and scheduled operations will not permit procurement through the regular Navy Supply System.

When authorized, the supply officer may make routine purchases of supplies and services when all of the following conditions exist:

- The supplies or services are not available at the local supply support activity.
- Supply department resources are sufficient to handle the additional workload involved without detrimental effects.
- The supply officer is reasonably familiar with the local market area.
- All transactions are made by an approved small purchase method providing for immediate delivery of the material purchased.

METHODS OF PURCHASE.—Purchases are made by one of the following methods:

- Purchase order for purchases not in excess of $2500.
- Imprest fund for cash purchases when the amount does not exceed $150 ($300 under emergency conditions).
- Orders under indefinite delivery-type contracts and blanket purchase agreements (BPAs) that have been negotiated by ashore activities.

CHAPTER 7

AUDIOVISUAL ADMINISTRATION

In order to efficiently operate within a Navy audiovisual activity or unit, all Navy photographers must be acquainted with the organization and administration of the Navy audiovisual structure.

This chapter is intended as an introduction to the Navy audiovisual structure. A more in-depth understanding of the organization and administration can be acquired from the *Navy Audiovisual Management and Operations Manual,* OPNAVINST 5290.1.

The *Navy Audiovisual Management and Operations Manual,* OPNAVINST 5290.1, governs the administration and operation of Navy audiovisual activities. It outlines the organization and administration of audiovisual units, and gives the policies and instructions for the use of photography and all other audiovisual products in the Navy.

NAVY AUDIOVISUAL ORGANIZATION

The Chief of Information (CHINFO) (OP-007) is the flag officer who represents all Navy audiovisual activities and is responsible to the CNO for the administration of the Naval Audiovisual Activities Program (NAVAP). The Assistant for Navy Audiovisual Management (OP-007D) is the principal adviser and assistant to the CHINFO for audiovisual (AV) matters, and is responsible for executing and implementing the Naval Audiovisual Activities Program.

MAJOR AUDIOVISUAL ACTIVITIES

The Naval Audiovisual Center (NAVAVCEN), located in Washington, D.C., is the major AV activity in the Navy. The Center provides general AV productions, products, and services to the Navy and other authorized organizations.

The Atlantic Fleet Audiovisual Command and the Pacific Fleet Audiovisual Command operate an extensive network of Base Audiovisual Service Centers (BAVSCs) and Base Audiovisual Service Center Detachments (BAVSCDs). Each of the audiovisual commands provides a wide variety of AV support, including extensive photographic, video, and audio services to fleet and shore activities. The fleet AV commands also have aerial, ground, and underwater photographic capabilities and deployable units.

AUDIOVISUAL FACILITIES

AV facilities (including photo labs) support military operations, contingencies, and emergencies. They range in type from the Naval Audiovisual Center to small detachments. These facilities produce AV products and/or provide other AV services.

Types of Navy AV Facilities

The Naval Audiovisual Center and the fleet audiovisual commands, as discussed, are extensive facilities which provide a wide range of services to the Navy and the fleet.

There are two other types of Navy AV facilities: Base Audiovisual Service Centers (BAVSCs) and Mission Dedicated Audiovisual Facilities (MDAVFs). Both types of AV facilities are authorized by OP-007D to meet specific requirements. In some cases, a BAVSC may be

authorized to establish detachments under its control to provide specialized support. These detachments are referred to as BAVSCDs.

BASE AUDIOVISUAL SERVICE CENTER (BAVSC).—A BAVSC is a single, consolidated management and service organization, which centrally manages and supports all AV activities and functions (except for a MDAVF) for a naval base or a geographic area. A BAVSC may be a single, consolidated AV facility. It usually is made up of components and functions that are physically separate. For example, a BAVSC management office may be located in one building, while other AV activities under its control, such as a still photographic laboratory, a graphic arts shop, and a storage area, may be located in various other buildings. Only one BAVSC is authorized for a naval base or geographic area.

BASE AUDIOVISUAL SERVICE CENTER DETACHMENT (BAVSCD).—A BAVSCD is a physically separate, operational element of a BAVSC, and has specific functional responsibilities. A BAVSCD is not separately funded or managed and is not identified by a Department of Defense Audiovisual Activity Authorization Number (DODAVAN). A BAVSCD will normally be authorized if:

- Operational needs require a detachment.
- It is not practical to physically consolidate all AV activities.
- Facilities are not physically suited to consolidated operations.

MISSION DEDICATED AUDIOVISUAL FACILITIES (MDAVF).—A mission dedicated AV facility is a fixed or mobile AV facility that is managed and funded separately by the organization authorized to operate it. An MDAVF is established and authorized to meet a unique requirement for AV products or services beyond the capability of a BAVSC or BAVSCD. It is limited to specific support services and functions. Because of its mission, distance from a BAVSC, or time constraints, the services provided by an MDAVF may duplicate those authorized and assigned to a BAVSC on the same base. An MDAVF is established ONLY to meet the needs of a specific mission.

AUDIOVISUAL FACILITY FUNCTIONS

An AV facility may be authorized to perform one or more of the following functions:

- Management and administration of AV activities
- Photography
- Video recording
- Audio recording
- Graphic arts
- Fabrication and reproduction of displays and devices
- Operating an AV library
- Loan of AV devices
- Loan of AV equipment
- Presentation support
- Audiovisual instruction
- Audiovisual consultation and design
- Instrumentation—originating, processing, or duplicating instrumentation (includes still and motion picture photography, audio and video recordings, and specialized time-lapse, high-speed, and oscilloscope recordings)
- Audiovisual production
- Audiovisual maintenance

Navy AV Facilities and Other Federal Activities

You may encounter some Navy AV facilities which support other activities, commands, DOD components, and Federal agencies. This support might include AV documentation, production, acquisition, reproduction, distribution or depository (storage or library) operations, and the more common AV services.

ASSIGNMENT OF AUDIOVISUAL PERSONNEL

As a Photographer's Mate, if you are assigned to an activity which is not authorized to operate an AV facility, you should be further assigned, on temporary duty or special detail, to the AV facility on the ship or station where the activity is based. However, there are exceptions to this.

When aircraft squadrons are not operating an authorized AV facility, they should assign sufficient AV personnel to the supporting AV facility to fulfill the squadron's AV support requirements. Aircrewmen in a flying status and personnel specially trained in aerial camera installation or aircraft camera control systems for designated reconnaissance aircraft should not normally be assigned to the ship's or station's AV facility except in emergency situations, and then, only when the assignment will not adversely affect the squadron's capability.

When a ship's AV facility is not operating, its AV personnel should be assigned temporarily to the activity that provides AV support for the ship.

If you are assigned to a major AV unit (Naval Audiovisual Center, Atlantic or Pacific Fleet Audiovisual Command, etc.) and are ordered to a naval activity or embarked in a naval vessel, you are assigned specific AV projects to accomplish. In this case you should not be assigned to the local AV facility or assigned other military duties that will interfere with the accomplishment of your assigned mission.

When Mobile Construction Battalions, having Photographer's Mates, are not operating their own AV facility, they should assign sufficient AV personnel (on temporary duty) to enable the supporting AV facility to fulfill their AV support requirements.

Reserve Personnel

Selected Reserve PHs on training duty should be assigned to the Naval Reserve unit, naval vessel, or station AV facility which can effectively train them for their assigned mobilization billet. Photo lab managers should coordinate with the command that will gain the reservist during a mobilization to develop and implement a training program to prepare the reservist for duty with the gaining command. This training may include state-of-the-art AV training, military training, formal schools, mobilization training, Personnel Qualification Standards (PQS), On the Job Training (OJT), and Job Qualification Requirements (JQR).

TRAINING OF AUDIOVISUAL PERSONNEL

The audiovisual manager or officer, and senior audiovisual personnel should ensure that their subordinates, including civilians and reservists, are trained in the latest AV techniques as well as rate or career training. This training should include both on the job and formal training. On the job training must, of course, be directed toward the job or mission at hand. However, training which will help the individual's career progression should not be neglected.

Naval Schools of Photography

The Naval Schools of Photography located in Pensacola, Florida, offer formal training courses in basic and advanced photographic and other AV techniques. Some of the subjects covered in the courses offered by the school include:

- Basic photography
- Advanced photography
- Photographic laboratory techniques
- Photographic quality assurance
- Printing and processing machines
- Color printing
- Copy and product photography
- Portrait photography
- Still documentary photography
- Slide presentation
- Motion picture and TV production
- AV equipment maintenance

Special Training

Advanced and specialized training is also available to qualified officer and enlisted

personnel and Navy civilians. Some of these special training courses cover the following subjects:

- Quality control of photographic materials and processing
- Motion picture editing
- Motion picture sound engineer
- Motion picture scriptwriting
- Photojournalism
- Cinematography

> The *Catalog of Navy Training Courses*, NAVEDTRA 10500, lists all the formal training courses offered to Navy photographers.

AUDIOVISUAL PRODUCTS AND SERVICES

All Navy AV facilities are established to provide AV support for official business only. Each AV organization may furnish one or more services such as photography, graphic arts, audio, television, or video support to meet all authorized requirements.

OBTAINING AV PRODUCTS AND SERVICES

Navy activities requesting AV products and services should submit an Audiovisual Activity Job Order, OPNAV Form 5290/1, to the AV facility.

Your facility may also receive requests from other DOD components, departments, and agencies of the Federal Government in the form of letters or messages, or on the OPNAV Form 5290/1.

The Audiovisual Activity Job Order Form (OPNAV 5290/1)

When the requester gives you the OPNAV Form 5290/1 with his entries, you must assign the job a Standardized Audiovisual Work Request Number (SAVWRN). This consists of the Department of Defense Audiovisual Activity Authorization Number (DODAVAN), a dash, a two-letter DOD-type work code, a dash, the last two digits of the Fiscal year, a dash, and a five-digit sequentially assigned work request number.

An example of a SAVWRN is: N0108-SP-84-01070

Authorized DOD-type work codes are:

AD — Aids, Displays, and Devices.

AS — Audio Services (except for audio recording made in conjunction with Motion Picture Photography and Television Broadcast/Documentation. These recordings will be counted under MS and TV, respectively).

GA — Graphic Arts.

MP — Motion Picture Photography.

MS — Sound recorded separately in conjunction with Motion Picture Photography.

RA — Radio Broadcast or Cablecast.

SP — Still Photography.

SV — Audiovisual Services (e.g., conference room AV support, projectionist services, consultant services, etc.).

TV — Television Broadcast or Cablecast.

VT — Videotape Recording.

Much of the information recorded on the job order will correlate to specific data entry requirements of the Audiovisual (AV) Annual Report. Instructions for transcribing job order data to the Audiovisual (AV) Annual Report are contained in the *Navy Audiovisual Management and Operations Manual,* OPNAVINST 5290.1.

SAFEGUARDING CLASSIFIED MATERIAL

Modern methods of conducting war and safeguarding our nation require the use of

tremendous amounts of information. This information is stowed away in books. It accumulates in reports. It is gathered by intelligence activities. It is transferred in letters, messages, photographs, and audio and video recordings, and it is sifted and organized in the minds of the men who are directing the war and keeping the peace. Much of this information could be extremely valuable to our enemies, and, therefore, must be classified and safeguarded in the interest of our national security.

As a Navy photographer, you may from time to time have access to classified information in the course of doing your job. Therefore, you MUST be aware of the importance of safeguarding any classified information you have access to.

The classification and security of information in the Navy is in accordance with OPNAVINST 5510.1, *Department of the Navy Information and Security Program Regulation*. A copy of this regulation should be available in every Navy photo lab or audiovisual facility where any classified information is maintained or worked with. When dealing with classified information, especially if you only handle it infrequently, do not depend on your memory. Refer to the regulation to make sure you safeguard it correctly.

The purpose of the security program is to protect classified material from unauthorized disclosure. And it is the responsibility of every Navy photographer to safeguard classified information.

To this end the Navy uses a security formula which is simple in principle. It is based on circulation control—the control of the dissemination of classified information. Therefore, knowledge or possession of classified information is permitted only to those who *actually* require it in the performance of their duties, and then only after they have been granted the appropriate security clearances. This principle is generally referred to as a "need to know" and is a prime requisite for access to classified information.

Access to classified material is not automatically granted because a person has the proper clearance, holds a particular billet, or is sufficiently senior in authority, but only if the criteria of proper clearance and "need to know" are both met.

CLASSIFICATION CATEGORIES

Official material that requires protection in the interest of national defense is *limited to three* categories of classification which, in descending order of importance, carry the designations Top Secret, Secret, or Confidential. No other designation is used to classify defense matter, as requiring protection in the interest of national defense, except as expressly provided by statute (e.g., Restricted Data and cryptographic systems). The words, matter, material, and information, as used in connection with classification, are synonymous.

Top Secret

Use of the classification Top Secret is limited to defense information or material that requires the highest degree of protection. The Top Secret classification is applied only to that information or material the defense aspect of which is paramount, and the unauthorized disclosure of which would reasonably be expected to cause exceptionally grave damage to the national security.

Secret

Material classified as Secret is limited to defense information or material the unauthorized disclosure of which would reasonably be expected to cause serious damage to the national security.

Confidential

Use of the classification Confidential is limited to national defense information or material the unauthorized disclosure of which could reasonably be expected to cause damage to the national security.

The security classifications are described in detail in OPNAVINST 5510.1.

RESTRICTED DATA

The term "Restricted Data" as defined in the Atomic Energy Act of 1954 means all data concerning (1) the design, manufacture, or utilization of atomic weapons; (2) the production of special nuclear material; or (3) the use of special nuclear material in the production of energy.

The term "Formerly Restricted Data" applies to classified defense information which (a) has been removed from the Restricted Data category pursuant to the Atomic Energy Act of 1954, and (b) cannot be released to foreign nationals except under specific international agreements.

Restricted Data and Formerly Restricted Data are NOT in themselves classification categories but are additional warning notices of special handling requirements. Thus a classification category is used with the warning notice wherever it is appropriate.

FOR OFFICIAL USE ONLY

The designation "For Official Use Only" is assigned to official information that requires protection in accordance with statutory requirements or in the public interest, but which does not require safeguarding in the interest of national defense.

A security classification may not be used to conceal violations of law; inefficiency; or administrative error; to prevent embarrassment to a person, organization or agency; or to restrain competition.

AUTHORITY TO CLASSIFY

The authority to assign a security classification is restricted to those officials who have been designated the authority in writing.

Derivative Classification

One important aspect of classification that is not clearly understood is the difference between original and derivative classification. Original classification is warranted only when an item of information is generated that requires classification and such classification cannot reasonably be derived from a previous classification of related information. For example, information pertaining to a technological breakthrough or a significant scientific advance will generally require the exercise of original classification authority.

The majority of classified material you work with is the product of derivative classification. As the word implies, this type of classification is based on and obtained from a previous classification. If the information to be presented is the same or closely related to other information for which a proper classification has already been assigned, derivative classification would be applied.

Suppose you are making photographs for a report of a Soviet warship in the South China Sea. If the report is based on a source document which states that such photographs should be classified, your classification is derived from that source. Or suppose you make pictures of a radar set that is classified Secret. Then the picture, including the negatives and any test prints, must also be classified Secret. The classification of the pictures is derived from the classification of the radar set. Only when guidance in any form is nonexistent is the classification an original one. Most of the information derivatively classified is taken from previously classified documents. Whenever you copy or extract classified information you must ensure that the extracted information bears the same classification in the new document (such as a photograph) as it did in the source document.

In marking a derivatively classified document, you must cite the source of that classification or authority (e.g., CNO ltr, ser OP-009 of 1 Oct 77) on the "classified by" line. Records must be available for the lifetime of the document to show the basis for classification or to trace the chain of classification authority.

CLASSIFICATION MARKINGS ON AUDIOVISUAL PRODUCTS

The requester of any AV product should determine the security classification of the product according to instructions contained in OPNAV-INST 5510.1. Each original AV product and copies of AV products which are classified must be marked with the appropriate security classification, authority, and declassification and downgrading instructions based on the original classification markings.

Marking Photographs

Both photographic prints and negatives which are classified must be marked with the appropriate classification and other applicable markings. Roll negatives will be marked at the beginning and end of the roll or strip on the base side. Single negatives cut from the roll or single sheet film negatives must also be appropriately marked on the base side. All 8 × 10 and larger classified prints are marked at the top and bottom on the back side with the appropriate classification. The downgrading and declassification instructions will be at the bottom on the back of all photographs. On prints smaller than 8 × 10 the classification marking need be applied only once. No matter what size the photographs are, whenever practicable, the markings should also appear once on the face side. In any case, the classification MUST be shown on the face side and may be attached by pressure sensitive tape or stapled strip if a stamp should not be used.

> Caution must be used when using instant picture film to photograph classified material. All component parts of the instant picture film must be removed from the camera and waste parts destroyed as classified waste.
>
> If the "negative" of instant picture film of a classified subject is left in the camera, then the camera shall be protected as classified material.
>
> As a matter of fact, any camera which contains exposed film of a classified subject must be afforded the same protection as the classified subject.

Marking Transparencies and Slides

Whenever possible, the applicable classification markings shall be shown clearly on the film or image area of each classified slide or transparency. If, in special circumstances, the classification marking cannot be shown in the image area, it must be shown on the slide or transparency border, holder, mount, or frame with the other applicable associated markings.

Marking Motion Picture Films

Classified motion picture films shall be marked at the beginning and end of each reel by titles bearing the appropriate classification and applicable associated markings. The markings must be visible when projected onto the screen. Reels containing classified film are to be kept in containers (film cans) conspicuously marked with the classification and applicable associated markings.

Video and Audio Recordings

Electronic recordings, sound or image, shall contain a statement of the assigned classification at the beginning and end. This statement, verbal or written, as appropriate, must provide adequate assurance that any listener or viewer will know that classified information of a specified level of classification is involved. Recordings shall be kept in containers or on reels that have conspicuous classification and applicable associated markings.

AUTOMATIC DOWNGRADING AND DECLASSIFICATION

The national interest demands that classified information be declassified and made available to the general public when its secrecy is no longer necessary or justified. In line with this principle, a command may declassify or assign a lower degree of classification to material it originated.

General Declassification Schedule

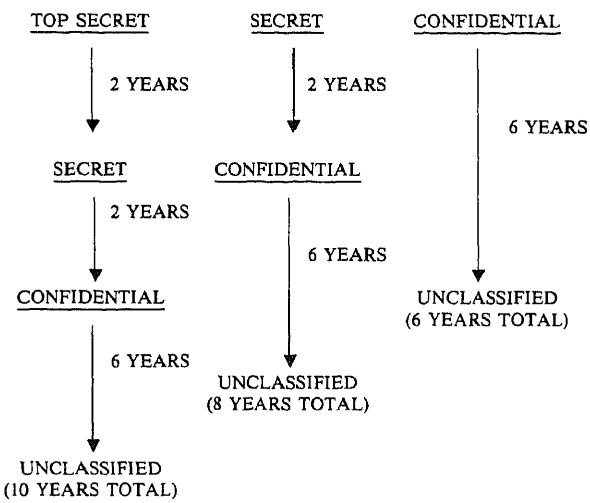
In 1972 the President issued an executive order that less official information would be classified, and more of it declassified so that the information which is classified could be better protected. As a result of this executive order, at the time of original classification, each piece of classified

schedule (GDS) as follows:

- Top Secret: Information and material is downgraded to Secret 2 calendar years after origination, downgraded to Confidential 4 years after origination, and declassified 10 years after origination.

- Secret: Information and material is downgraded to Confidential 2 calendar years after origination and declassified 8 years after origination.

- Confidential: Information and material is declassified 6 calendar years after origination.



General Declassification Schedule

Certain information is excluded from the GDS when the information is of a very delicate nature. Exemptions are made when—

- Furnished by foreign governments or international organizations and held by the United States with the understanding that it be kept in confidence.

- Specifically covered by statute (e.g., Restricted Data and Formerly Restricted Data) or pertaining to cryptography, or disclosing intelligence sources or methods.

security.

- Disclosure would place a person in immediate jeopardy.

DISCLOSURE OF CLASSIFIED MATERIAL

When classified matter is entrusted or made known to you, you must protect it against loss or compromise. You are responsible for any act or failure on your part that may in any way contribute to its loss, compromise, or unauthorized disclosure. This includes information that is transmitted orally.

If you are found responsible for the loss, compromise, or unauthorized disclosure of classified matter, or if you violate security regulations, you can expect to be promptly and adequately disciplined. Disciplinary action may include, in the case of military personnel, trial by court-martial or, in the case of civilians, prosecution under Title 18, United States Code, as amended, or other Federal statutes as appropriate.

SPECIFIC PROTECTIVE MEASURES

There are, in general, four ways in which classified information is protected: censorship, physical security, transmission security, and cryptographic security. As a photographer, you will be primarily concerned with personal censorship and physical security.

Personal Censorship

Censorship places a barrier between classified information and unauthorized persons by preventing its disclosure in letters, conversations, and personal contacts. It means the shutting off of information at the source, except in making official use of it, and depends to a large extent on the integrity and discretion of the individual.

Physical Security

Physical security as used here is concerned with the safeguarding of documents, photographs, and

other items which contain classified information. Later in this chapter we will discuss another form of physical security used to physically safeguard property and material at Navy shore activities.

The physical security we speak of for now is concerned with protecting *classified* documents, devices, and material so that they never fall into the hands of unauthorized persons or come within either optical or camera range of actual or possible enemies.

When working with classified matter you must protect that matter from being seen by any unauthorized individual, either military or civilian. There is no reason for any person to have access to classified material until it becomes necessary to do so to discharge their duties properly.

Classified material may neither be removed from its designated working space nor left unguarded. When not actually in use, it is kept locked in the proper accommodation, for a single glance at a message or a cryptographic aid may be enough to betray the system. Another danger is that a photograph could be taken in a split second with a concealed camera.

DESTRUCTION OF CLASSIFIED AUDIOVISUAL PRODUCTS

When classified audiovisual products, such as photographs, videotapes, or audio recordings, are no longer needed or useful, they are destroyed, *never* discarded in wastebaskets for ordinary disposal.

Destruction of classified material must be accomplished and witnessed by persons who are cleared to the level of the material being destroyed. Two witnesses are required for the destruction of Top Secret material and one witness is required for the destruction of Secret and Confidential information.

A record of destruction is required for Top Secret and Secret material but not for Confidential material. Destruction may be recorded on OPNAV Form 5511/12 (Classified Material Destruction Report) or on any other record which includes complete identification of the material, number of copies destroyed, and the date of destruction. The record of destruction must be signed by the people who witnessed the destruction and retained for 2 years.

Classified documents can be destroyed by burning, pulping, pulverizing, or shredding. When destruction is accomplished by means other than shredding, the residue must be inspected to ensure complete mutilation.

SECURITY AREAS

Audiovisual spaces or buildings that contain classified matter are known as security (sensitive) areas. The areas have varying degrees of security, depending on their purpose and the nature of the work and information or materials concerned. All security areas should be clearly marked by signs reading, "Restricted Area." To meet different levels of security sensitivity, three types of security areas are established.

Exclusion Area

Spaces requiring the strictest control of access are designated exclusion areas. They contain classified matter of such nature that admittance to the area permits, for all practical purposes, access to such matter.

An exclusion area is fully enclosed by a perimeter barrier of solid construction. All entrances and exits are guarded, and only those persons whose duties require access and who possess appropriate security clearances are authorized to enter.

Limited Area

A limited area is one in which the uncontrolled movement of personnel permits access to classified information. Within the area, access may be prevented by escort and other internal controls.

The area is enclosed by a clearly defined perimeter barrier. Entrances and exits are guarded or controlled by attendants to check personal identification. The area may be protected by an automatic alarm system.

Most Navy photo labs and AV facilities should be considered at least as limited areas when classified work is in progress. Any visitors should be escorted when in the spaces. If classified work is in progress it should be excluded from the visitors' view. Even when classified work is not in progress, you should operate your AV facility as a limited area. Most of the time there will be expensive photographic and other AV equipment laying about, some of it small and easily

pilferable, such as 35mm cameras and lenses. By always operating an AV facility at least as a limited area, you will not only be safeguarding classified information but expensive equipment also.

Controlled Area

A controlled area usually does not contain classified information. It serves as a buffer zone to provide greater administrative control, safety, and protection for the limited or exclusion areas. These areas require personnel identification and control systems adequate to limit admittance to those having bona fide need for access to the area.

Passageways or spaces surrounding or adjacent to limited or exclusion areas may be designated controlled areas.

SAFEKEEPING AND STORAGE OF CLASSIFIED MATERIAL

Classified information or material cannot be used, held, or stored where there are not facilities adequate to prevent unauthorized persons from gaining access to it. The security requirements must permit the accomplishment of essential functions while affording a reasonable degree of security with a minimum calculated risk. In the Navy, the commanding officer is directly responsible for safeguarding all classified information within his command and for assuring that classified material, not in actual use by appropriately cleared personnel or under his direct personal observation, is stored in the prescribed manner.

Storage

Whenever classified material is not under the personnel control and observation of an authorized person, it will be guarded or stored in a locked security container.

Top Secret material should be stored in a safe or safe-type steel file container having a three-position combination lock as approved by the General Services Administration (GSA), or a class A vault which meets the standards established by the Director of Naval Intelligence. An alarm-protected area may be used to protect Top Secret material, if the local responsible official decides it affords protection equal to, or better than, the safe, steel file, or vault. The alarm-protected area must provide a physical barrier which prevents removal of the material, and prevents the material being seen when observation would result in the compromise of the material.

Secret and Confidential material may be stored in the manner authorized for Top Secret; or, in a class B vault, a vault-type room, or a secure storage room which has been approved in accordance with the standards prescribed by the Director of Naval Intelligence.

> Because they increase the risk of theft, valuables such as money, jewels, precious metals, narcotics, etc., shall not be held in containers (safes, vaults, etc.) used to store classified materials. In other words, *only classified material may be stored in a classified material container.*

Container Designations and Combinations

Each container used for the storage of classified material is assigned a number or symbol for identification purposes. The identifying *numbers* or *symbols* will be located in a conspicuous location on the outside of the container. Each container will also be designated as to the highest category of classified material to be stored therein. However, this designation *will not* be externally marked on the container.

The combination of a container used for the stowage of classified material is assigned a security classification equal to the highest category of classified material authorized to be stored in the container. Records of combinations are sealed in envelopes (OPNAV Form 5511/2) and kept by the security manager, duty officer, communications officer, or other persons designated by the commanding officer. Combinations will be changed under any of the following conditions:

- When a safe, etc., is first placed into use.

- Annually.

- When the combination or record of combinations has been compromised or the security container has been discovered unlocked and unattended.

and when the security clearance of an individual knowing the combination is reduced, suspended, or revoked.

When selecting new combination numbers for a security container, multiples of 5, simple ascending or descending numerical series, and personal data, such as birthdays and serial numbers, should be avoided. The same combination cannot be used for more than one container.

Combinations to security containers are to be changed only by a person who is cleared for the highest level of classified material stored in the container.

When a security container is taken out of service, built-in combination locks will be reset to the standard combination 50-25-50. Combination padlocks will be reset to 10-20-30.

RECEIPT SYSTEM FOR CLASSIFIED MATERIAL

Whenever Top Secret material changes hands it must be done under a continuous chain of receipts. For example, when a requester brings a Top Secret photograph to the lab to be copied, the photographer receiving the job must sign a receipt for the Top Secret picture. When the photographer turns the picture over to the cameraman, the cameraman must sign the receipt; when the cameraman turns the processed film over to the printer, the printer signs for the negative and the print; and so on until the requester again signs the receipt for the completed job.

Secret material, on the other hand, needs to be covered by a receipt only when it is transferred, either permanently or temporarily, to another command or other authorized addresses.

The receipts for Top Secret and Secret material will be provided by the transmitter or the person requesting the copy work in the above example. A postcard receipt form, such as OPNAV Form 5511/10 (Record of Receipt), may be used for this purpose. Receipt forms will be unclassified and contain only as much information as is necessary to identify the material being transmitted. No classified information shall be included on a receipt. Receipts are retained for at least 2 years.

Receipts for Confidential material are not required but may be used.

PROGRAM REGULATION, OPNAVINST 5510.1

The foregoing information regarding "Safeguarding Classified Material" is provided to you as a general guide only. *It is not to be interpreted as an authority.*

Whenever you handle classified information or if you have any questions about classified information security matters you MUST refer to the *Department of the Navy Information Security Program Regulation,* OPNAVINST 5510.1.

Another very good source for security information is your command's security manager.

PHYSICAL SECURITY

Physical security is a part of an overall Navy program which is concerned with the physical measures designed to prevent unauthorized access to equipment, facilities, and materials and to safeguard them against espionage, sabotage, damage, theft, or other acts which would in some degree lessen the ability of a Navy activity to perform its mission or affect overall material security interests.

Audiovisual facilities and photo labs are a part of this physical security program. Physical security of an AV facility is a direct, immediate, legal, and moral responsibility of every photographer assigned to the unit or activity. You should become familiar with the *United States Navy Physical Security Manual,* OPNAVINST 5510.45, which sets forth policy and establishes uniform minimum standards for security measures to be used to physically safeguard our Navy's property and material.

As we said before, Navy AV facilities should be considered limited access areas. The reception or job order desk area of an AV facility is the only place within the facility that visitors or people from outside the assigned crew should be allowed to visit unescorted. Beyond the reception area there should be a definite, well-defined limiting barrier—either a warning sign or locked gate or door depending on the degree of security required—beyond which unauthorized people will know they should not enter.

ESCORTING VISITORS

Procedures for the control of people entering the restricted areas of an AV facility should include, as a minimum, an escort system. Escorting is a method for controlling personnel within the lab who are not normally authorized access. Whether or not the escort remains with the visitor during the entire time of the visit is determined by the amount of security required, the purpose of the visit, and by local written policy. Utility and maintenance personnel performing work at regular or irregular intervals and for short working periods should be handled by the same procedures adopted for the control of visitors.

A master chief photographer was assigned to a small photo lab where no classified work was performed. Prior to his arrival, access to the photo lab was free and uncontrolled to just about everyone on the station. When the master chief took charge of the lab, he immediately initiated a visitor control system and had a physical barrier erected between the job control desk and the production spaces.

Even after explaining his reasons for this action, as you can expect, there was, for a time, much grumbling and complaining from both the PHs who worked in the lab and from people who previously had free access to the lab.

The reasons the master chief gave for the new visitor control system were:

- Even though the lab does not engage in any classified work, the photographers must be made aware of the need for security. One of the results of the visitor control system then was training for the PHs who may someday be assigned to a lab where visitor control would be necessary to safeguard classified information. By following a visitor control system in this small lab the photographers would become accustomed to escorting visitors, the results of which might prevent the compromise of classified information or the disappearance of equipment at another duty station.

- People are curious and like to look at pictures. When visitors are allowed free, unescorted access to the lab, they will probably go through the pictures and negatives in the finishing area. They probably won't steal any pictures, but will they put them back where they came from? Or will the finishing crew have to re-sort all the jobs? (The crew finally admitted that when the lab was "open" to everyone, pictures often turned up missing or misplaced.)

- To the visitors who were upset over the new system the master chief explained it this way: "If you have unlimited access to the lab, and, say a 35mm camera comes up missing, you automatically become suspect and NIS will want to talk to you about it. However, if you are escorted during your visits to the lab everyone will know you couldn't have taken the camera."

These were not the only reasons the master chief gave for a visitor control

KEY CONTROL

The number of keys issued to the crew of an AV facility or spaces should be kept to the absolute minimum required for efficient operation of the facility. Generally, keys to the facility and all facility spaces should be issued on a semipermanent basis only to the audiovisual manager or officer, the audiovisual chief, and the production petty officer. Other members of the crew can be issued keys to the spaces within the facility where they work; e.g., the supply PO should have a key to the storeroom, the TV studio PO to the TV studio, etc. A set of all the keys that the duty section needs should be part of the duty section leader's watch equipment. When he assumes the duty, he should make an entry in the duty section logbook indicating receipt of *all* the keys from the offgoing section leader.

All keys should be given a serial number and plainly marked "Prop U.S. Gov't. Do Not Duplicate." Never mark a key with a building or space name or number. If the key is lost, and the building or space number or name is on it, the finder would know where to go to use the key. By placing only a serial number on a key, it can be identified if and when it is turned in to the OOD, etc.

Keys issued on a semipermanent basis should be signed for in the master key log. When a person to whom a key has been issued is transferred or no longer has a distinct need for the key, it should be returned to the key custodian. If a key is lost, the lock to which the key goes must be changed.

DOORS, WINDOWS, AND SKYLIGHTS

There should be no more doors to a limited access area than are needed for efficient operation and safety. When not in active use, doors should be locked and inspected frequently.

Windows, skylights, and other openings which have an area large enough for someone to enter through should be protected by securely fastened bars, grills, or other equivalent means. Some provision should be made to break open these barriers if necessary to escape from a fire.

CHAPTER 8

AUDIOVISUAL SUPPLY

In every audiovisual facility someone has to be in charge of maintaining supplies and ordering more as needed. Sooner or later you may have this responsibility. Every sailor is a little afraid of the Navy Supply System at first. This is understandable since it is such a big system. What is even more awesome is that it is only part of a bigger supply system which includes all of the Government, and even serves allied military in NATO. Getting what you need from such a system is a lot different from shopping at the Five and Dime. Here we will give you some information and insights into using the supply system so that you can approach it with confidence. The first step in understanding the supply system is to realize the extent of the source of supply which you can draw on.

THE SOURCE

Your supplies are produced, for the most part, by American industry. They are made under contract, purchased in wholesale lots, and sometimes bought as individual pieces by various Government agencies, including the Navy. When you order supplies you tap into this vast reservoir of material. To fill your order the Navy Supply System draws on its own resources, or upon other services, or on material and equipment held by civilian agencies of the Government. To do this requires a system of cataloging everything the Government has in store.

A very large part of the business of the Chief of Naval Operations is managing all the property, or "hardware" as we call it, of the Navy. If you stop to think of all the bases, buildings, ships, planes, vehicles, and parts the Navy owns, you can imagine how big the job is. To assist him, CNO is aided by the Chief of Naval Material, who handle the details, the NMC is supported by the "Systems Commands" which are:

- Naval Air Systems Command
- Naval Electronics Systems Command
- Naval Facilities Engineering Command
- Naval Sea Systems Command
- Naval Supply Systems Command

As a Photographer's Mate, the Naval Supply Systems Command (NAVSUPSYSCOM) and the Naval Air Systems Command (NAVAIRSYSCOM) are of particular interest to you. These two commands manage the inventories of the types of supplies you use the most. Navy inventory managers are responsible for assigned groups or categories of items of supply. Navy inventory managers include the systems commands, and also project managers, bureaus, offices, and inventory control points (ICPs) under the command of NAVSUPSYSCOM.

The Naval Air Systems Command is the inventory manager for audiovisual equipment, therefore, NAVAIRSYSCOM is of interest to you. Although an inventory manager is responsible for keeping adequate amounts of supplies on hand, these commands can't keep all the stuff in their backyards in Washington. To make supplies available to the fleet, they must be stocked at locations near where the fleet is.

STOCK POINTS

Stock points consist of naval supply centers (NSCs), naval supply depots (NSDs), and industrial naval air stations (INASs).

The mission of these activities is to furnish supply support to fleet units, shore activities, transient ships, and overseas bases. They do this

services. The following activities are stock points for the Navy Supply System:

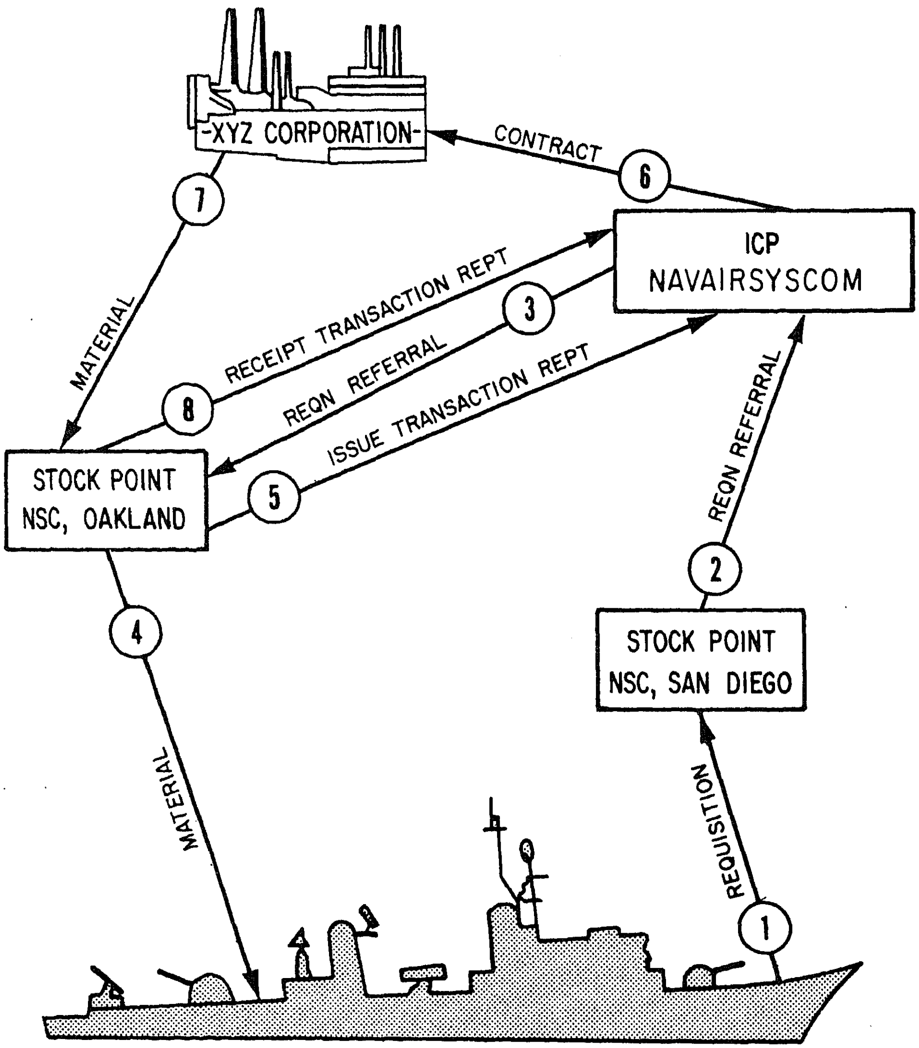
NSC Charleston	NSD Yokosuka
NSC Norfolk	NAS Alameda
NSC Oakland	MCAS Cherry Point
NSC Pearl Harbor	NAS Jacksonville
NSC Puget Sound	NAS Norfolk
NSC San Diego	NAS North Island
NSD Guam	NAS Pensacola
NSD Subic Bay	

ment.

2. *After researching their records a[r]... determining that the item is not in stock, NS[C] San Diego refers the requisition to NAVAIRSY[S]COM.*

3. *NAVAIRSYSCOM after researching the[ir] master records and determining that the request[ed] item is in stock at NSC Oakland refers t[he] requisition to NSC Oakland.*

4. *NSC Oakland issues the item to US[S] Chance.*



5. *NSC Oakland makes an issue transaction report to NAVAIRSYSCOM.*

6. *NAVAIRSYSCOM after applying the issue reports to its master record ascertains that NSC Oakland's stock of the item is below the required level and issues a contract to the XYZ Corporation to replenish NSC Oakland's stock.*

7. *The XYZ Corporation ships the material to NSC Oakland.*

8. *NSC Oakland makes a receipt transaction report to NAVAIRSYSCOM.*

General Services Administration

The General Services Administration (GSA), though not a part of the Department of Defense, does furnish some materials and services to the Armed Forces. It is responsible for supporting all Federal agencies.

GSA maintains stock points at several locations throughout the country. It also has open end contracts with major suppliers for such items as typewriters, adding machines, and calculators. A good portion of the Navy's administrative supplies and equipment are procured from this source.

The GSA makes contracts with many manufacturers to buy at an agreed price. Nearly all audiovisual materials used by the Navy are on "GSA Schedule," as it is called. This means that a local store, carrying material you need, *may* sell it to you at the established GSA price. However, material which is Navy stocked must be ordered from the Navy Supply System. Prices vary between the two systems; sometimes you will pay more when ordering from Navy stock than you would pay through the GSA Schedule. The GSA "Government prices" are generally 20 percent or more below the retail selling price. However, you must "buy Navy" first.

SUPPLY CATALOGS

There are over four million types of supply items in the Department of Defense Supply System. The Navy Supply System alone stocks over one million items. So that you may have access to the entire resources of the Government, a common language has been developed—the Federal Catalog System.

FEDERAL CATALOG SYSTEM

The Defense Logistics Agency (DLA) administers the Federal Catalog System which encompasses all items carried by the Department of Defense and the civil agencies of the Federal Government. The identification of an item in this catalog system is used for all supply functions related to the item from purchase to final disposal. The identification of an item in the Federal Catalog System begins with giving it a Federal Supply Classification number.

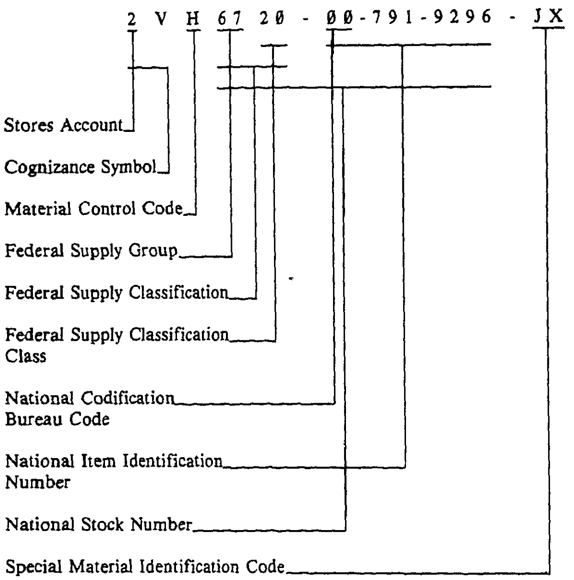
Federal Supply Classification System

Each item is classified in one, and only one, four-digit Federal Supply Classification (FSC) number. The first two digits denote the group or major division of commodities; the last two digits are the class or subdivision of commodities within a group. As presently established, the FSC has 90 groups (some currently unassigned). These stock groups cover rather broad categories of material. The second two numbers, designating the class within the group, allow more specific identification. Class numbers may identify the commodities in accordance with their physical or performance characteristics, or may be based on the fact that the items in the class are usually requisitioned or issued together. Below is an example of how the classes are used to divide types of material within a stock group, and create the FSC number.

Group 67 Photographic Equipment	6710—Cameras, Motion Picture 6720—Cameras, Still Picture 6730—Projection Equipment 6740—Photographic Developing and Finishing Equipment 6750—Photographic Supplies 6760—Photographic Accessories 6770—Film, Processed 6780—Photographic Sets, Kits, and Outfits

National Stock Number

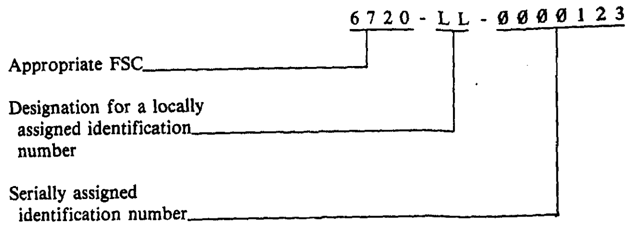
As you can imagine the Federal Supply Classification number is not enough to identify a specific supply item. When enough identification is added, we have the National Stock Number (NSN). The following example illustrates all the elements of the NSN in their proper sequential order:



A very important part of the NSN is made up of the nine digits that comprise the National Codification Bureau (NCB) code and the National Item Identification Number (NIIN). These numbers identify supply items used by DOD. They are used independently to identify items, and most supply catalogs you use are arranged in NIIN order.

NAVY ITEM CONTROL NUMBERS.—Items of material that are not included in the Federal Catalog System, but which are stocked or monitored in the Navy Supply System, are identified by Navy Item Control Numbers (NICNs). NICNs are 13-character item identification numbers which are assigned by Navy inventory managers for permanent or temporary control of selected non-NSN items.

LOCAL ITEM CONTROL NUMBER.—Local item control numbers may be assigned to stocked consumable items such as special developers and camera accessories, etc., which are not otherwise identified. A local item number consists of 13 characters. The first four are numerics that correspond to the FSC of similar NSN items; the fifth and sixth (NCB code area) are "LL" and the remaining seven are all numerics. For example:



Locally assigned item control numbers are authorized for local use only (i.e., for shipboard stock records, bin tags, issue documents, etc.). They are not used in requisitions since such item identification numbers would be meaningless to the supply source.

IDENTIFICATION

By now you can see that the key to getting material from "supply" is to break the code—to get the National Stock Number for the item. But how?

There are two simple ways to do it, as long as they work. The first is to make sure that all your supplies are identified by their numbers—label the bins, put identification tags on the items, and include the numbers on your inventory list. Then, when you start to run short, you have the number right at hand. Most supply POs use this as the basic method, and keep careful records of their stock items. Occasionally you need something new; not a replacement. Then the second method is used. This method is used basically to keep on the good side of your local supply department, so you can get their expert help.

The storekeepers know the system, and can help you quite a bit. However, they do not know your equipment and supplies, so you will possibly have to locate in the catalogs the specific item you want.

One secret of keeping the storekeepers helpful is to not blame them whenever something goes wrong. Enough of this and they will close down for inventory whenever they see you coming. The supply system is very complete and highly automated. Most foul-ups occur because the

requisition contained an error. The people and machines in the system assume you knew what you were doing when you filled it out. If you were off one digit in the stock number you may receive an airplane engine instead of a typewriter, so always be careful.

If you use the wrong NSN to requisition material, you will probably receive stock that you cannot use and certainly not the material desired. Not only will the unit have spent its money uselessly, but stock will have been withdrawn from the supply system that may be urgently needed by another ship or station. There is also the additional delay of waiting for the correct material to be reordered and received.

Even when you are replenishing supplies it is a good idea to check the current stock numbers. Normally, if a supply item becomes obsolete, the supply system will automatically fill your order with the current item which replaced it. However, there are times when the substitute item is very different or other uncertainty exists as to what you really want. Then your requisition will be returned, and you have wasted time.

A number of catalogs and lists are available for your use in locating the current ordering information. If you are ordering replacement supplies or equipping an activity, you will use the *Management List-Navy*, the *Afloat Shopping Guide*, your activity's allowance lists, the *DOD Consolidated Federal Supply Catalog*, the *Photographic Equipment List*, the *Navy Stock List*, and the *GSA Catalog*. If you have to order repair parts, the Manufacturers' Manuals, the Illustrated Parts Breakdown, and the *Consolidated Master Cross-Reference List* (C-MCRL) or (CRL) allow you to trace the part number given by the manufacturer and locate the corresponding NSN. For ordering publications and keeping your technical and administrative library up to date, you use the *Navy Stock List of Publications and Forms*. Let's see how you use these and other references.

MANAGEMENT LIST-NAVY

You will find the *Management List-Navy* (ML-N) very helpful for preparing requisitions. It lists stock items in NIIN sequence and gives stock numbers, units of issue, unit prices, shelf-life codes, and other pertinent information on items which the Navy orders. It contains a record of deleted and superseded items with appropriate phrases to indicate disposition action and what item has replaced the deleted item.

A sample page of the ML-N is shown here.

FEDERAL SUPPLY CLASSIFICATION	NATIONAL ITEM IDENTIFICATION NUMBER	SOURCE OF SUPPLY	ACQUISITION ADVICE CODE	QUANTITY PER UNIT PACK	UNIT OF ISSUE		SHELF LIFE CODE	REPAIRABILITY CODE	SECURITY CLASSIFICATION CODE	COGNIZANCE SYMBOL	MATERIAL MANAGEMENT CODE	DEMILITARIZATION CODE	
FSC	NIIN	SOS	AAC	QUP	UI	UNIT PRICE	SLC	REP	SEC	COG	MMC	DML	ITEM NAME

AFLOAT SHOPPING GUIDE

The *Afloat Shopping Guide* (ASG) is one of your most frequently used identification tools. It is designed to assist you in identifying an NSN for those items of supply not related to a part/reference number. Descriptions and illustrations may be used to determine substitutions and applicable NSNs in the general hardware area.

The ASG is comprised of two volumes containing descriptive data and illustrations accompanied by indexes of groups/classes included; alphabetic and NIIN listing of included items. The NIIN index also indicates the availability of an item from the Mobile Logistics Support Forces. A page from the ASG is shown here.

DOD CONSOLIDATED FEDERAL SUPPLY CATALOG 6700IL

The *DOD Consolidated Federal Supply Catalog* 6700IL identifies FSC Class 6700 materials including FSC 6750 photographic supplies stocked by the Defense General Supply Center.

PHOTOGRAPHIC EQUIPMENT LIST

The *Photographic Equipment List* (PEL) lists supporting repair parts for repairable photographic equipment. All active PELs are listed in Section C-0001 of the *List of Navy Publications,* issued by the Aviation Supply Office (ASO).

NAVY STOCK LIST

The part of the *Navy Stock List* that is used most by Photographer's Mates is the *Photographic Major Assemblies and Related Components and Equipment,* ASO E-6789.

This publication lists standard stock photographic materials under the control of the Aviation Supply Office and NAVAIRSYSCOM. It describes and identifies the equipment and materials listed. The primary equipments are listed alphabetically by name. Each primary equipment

when applicable, by related equipments and their components. Within name, arrangement is alphanumerical by type designation, or by physical characteristics if no type designation exists.

ALLOWANCE LISTS

Allowance lists specify the kind and quantity of equipment, equipage, repair parts, and supporting materials that a unit should have. Of particular interest to Navy photographers are the *Allowance Lists,* NAVAIR 00-35QP series, published by ASO under the direction of NAVAIRSYSCOM, containing authorized allowances of photographic equipment and materials.

It is the policy of NAVAIRSYSCOM to make available to each Navy AV activity the authorized equipment and repair parts necessary to ensure operational readiness. Allowance list requirements are not mandatory and deviations can be approved.

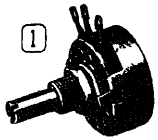
GSA CATALOG

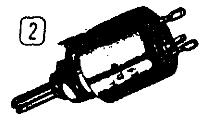
The General Services Administration (GSA) exercises inventory control over and is responsible for cataloging nonmilitary items in general use by both military and civil agencies of the United States Government. The *GSA Supply Catalog* is a handy reference in identifying consumable-type material.

It is published in four volumes. Volume 1 contains an alphabetical index. Volume 2 contains an NSN index with current prices and other ordering information, and changes to Volume 1. Volume 3 contains descriptions of material, in a format similar to the ASG. Volume 4 is a price list for Volume 3.

NAVY STOCK LIST OF PUBLICATIONS AND FORMS

The *Navy Stock List of Publications and*

1 

2 

Specification Data–MIL-R-94

TYPE	TAPER	WATTS	BUSHING SIZE	SHAFT DIA.	BODY DIM.	FIG
RV2	A	1	3/8-32	1/4	.64 x .42	1
RV2	C	1/2	3/8-32	1/4	.64 x .42	1
RV4	A	2	3/8-32	1/4	.90 x .45	1
RV4	C, F	1	3/8-32	1/4	.90 x .45	1
RV5	A	1/2	1/4-32	1/8	.75 x .37	1
RV6	A	1/2	1/4-32	1/8	.50 x .37	2
RV6	C, F	1/4	1/4-32	1/8	.50 x .37	2

1 WATT

Locking bushing, 5/8 in. lg shaft.

	Ohms	Mil Type RV2LAYSA
00-815-5498	10K	103A

Standard bushing, 7/8 in. lg shaft.

	Ohms	Mil Type RV2N
00-835-8870	1.5K	AYSD152A
00-577-6803	10K	AYSD103A
00-964-6059*	10K	BYSD103A
00-853-0793	100K	AYSD104A

*With SPST switch.

2 WATT

Locking bushing, 5/8 in. lg shaft.

	Ohms	Mil Type RV4LAYSA
00-681-8688	50	500A
00-503-5984	100	101A
00-503-6218	250	251A
00-539-4897	500	501A
00-646-5958	1K	102A
00-539-2567	2.5K	252A
00-539-2479	5K	502A
00-518-5595	10K	103A
00-501-7314	25K	253A
00-501-5184	50K	503A
00-665-4992	100K	104A
00-552-2093	250K	254A
00-518-5593	500K	504A
00-518-5609	1MEG	105A
00-552-5487	5MEG	505A

Locking bushing, 7/8 in. lg shaft.

	Ohms	Mil Type RV4LAYSD
00-577-3717	2.5K	252A
00-577-3645	25K	253A
00-556-3042	100K	104A
00-023-7931	1MEG	105A

Standard bushing, 1/2 in. lg shaft.

	Ohms	Mil Type RV4NAYSB
00-542-8046	1K	102A
00-646-5957	10K	103A
00-646-5981	25K	253A
00-643-6284	50K	503A
00-542-8048	100K	104A
00-542-8051	1MEG	105A

Standard bushing, 7/8 in. lg shaft.

	Ohms	Mil Type RV4NAYSD
00-556-3041	100	101A
00-552-2859	500	501A
00-552-5478	1K	102A
00-577-9976*	1K	
00-539-5013	2.5K	252A
00-643-5626	5K	502A
00-578-4471	7.5K	752A
00-556-3350	10K	103A
00-552-5479	15K	153A
00-539-1559	25K	253A
00-539-4900	50K	503A
00-644-6693	100K	104A
00-552-5476	250K	254A
00-893-9499	500K	504A
00-501-7307	1.5MEG	155A
00-655-3312	2MEG	205A

*With SPST switch, MIL Spec type RV4NBYSD102A.

Standard bushing, 1-1/4 in. lg shaft.

	Ohms	Mil Type RV4NAYSG
00-811-1750	2.5K	252A

Standard bushing, 2-1/2 in. lg shaft.

	Ohms	Mil Type RV4NAYSK
00-539-4999	100	101A
00-539-2568	250	251A
00-557-4637	500	501A
00-500-7588	1K	102A
00-542-8724	2.5K	252A
00-666-1036	5K	502A
00-665-5095	10K	103A
00-581-2846*	10K	
00-500-7879	25K	253A
00-542-8744	50K	503A
00-339-4576	100K	104A
00-539-4578	250K	254A
00-539-4998	500K	504A
00-552-2254	1MEG	105A

*With SPST switch, MIL Spec type RV4NBYSK103A

C TAPER

1/4 WATT

Standard bushing, 7/8 in. lg shaft.

	Ohms	Mil Type RV5NAYSD
00-802-7951	5K	502C

	Ohms	Mil Type RV6NAYSD
00-851-5648	5K	502C
00-954-4038	10K	103C

1 WATT

Locking bushing, 7/8 in. lg shaft.

	Ohms	Mil Type RV4LAYSA
00-578-9051	1MEG	105C

Standard bushing, 7/8 in. lg shaft.

	Ohms	Mil Type RV4NAYSD
00-681-6172	500	501C
00-552-3480	10K	103C

Standard bushing, 7/8 in. lg. (Shaft and panel sealed.)

	Ohms	Mil Type RV4SAYSD
00-542-9406	500	501C

Standard bushing, 2-1/2 in. lg shaft.

	Ohms	Mil Type RV4NAYSK
00-553-9970	2.5K	252C
00-578-4134	50K	503C

F TAPER

1/4 WATT

Locking bushing, 5/8 in. lg shaft.

	Ohms	Mil Type RV6LAYSA
00-752-3377	50K	503E

1 WATT

Locking bushing, 5/8 in. lg shaft.

	Ohms	Mil Type RV4LAYSA
00-683-5996	10K	103E

INDUSTRIAL TYPE. A taper. Fully inclosed body with 1/4 in. diameter slotted shaft and mounted by a 3/8 - 32 thread bushing.

Single section

2-1/4 Watt at 70 deg C, body dimension. 11/16 in. lg x 1-5/32 in. diameter, 1-7/16 in. lg shaft, panel sealed bushing, 3 solder lug terminals.

00-482-4992 350 OHMS 10% tol

3 Sections

2 Watt at 70 deg C, body dimension. 1-29/32 in. lg x 1-5/32 in. diameter, 5/8 in. lg shaft, 9 solder lug terminals.

00-264-7818 2.5 meg, 2.5 meg, 20%, 25K, 10%

Page from the Afloat Shopping Guide.

as the "I Cog Catalog," consists of three sections:

Section I —Alphabetic/Numeric Listing of Form Numbers, Publications and Hull Numbers; Electronic Model Numbers and Standard Subject Identification Code for Cog 1I Forms.

Section II —Alphabetic Listing of Publications and Forms by Title/Nomenclature.

Section III—Numeric Listing of Publications and Forms by Stock Number followed by NAVAIRSYSCOM Technical Directives (by type and directive number).

Publications and Forms are sequenced together. Microfiche editions of NAVSUP P-2002 are issued quarterly, each edition reflects all current Cog ØI and 1I Publications and Forms. Section I and Section III reflect information such as Canceled, No Superseding Item, Superseded By, and Replaced By.

The Introduction to *Navy Stock List of Publications and Forms* provides detailed information about the columnar arrangement of the stock list. Additionally, it provides the instructions needed to requisition publications and forms.

LOAD LISTS

Load lists are an inventory of material carried by Mobile Logistics Support Force (MLSF) ships (including tenders and repair ships), or bases to fulfill assigned supply support of fleet units. They, like allowance lists, will help you determine NSNs for material requirements.

MANUFACTURERS' PART NUMBERS

When replacement parts are needed, either to repair equipment or as a spares inventory so repairs can be made when you are deployed, you usually have to start with the number of the part which was assigned by the manufacturer. A knowledge of some of the various methods of identifying an item to a stock number, a stock number to an item, or the part to a usable number other than a stock number may prove to be very helpful.

Normally, the manufacturers of parts affix a part number on each item manufactured. The use of this manufacturer's part number and the knowledge of the part's application normally lead to the positive identification of the part's nomenclature and National Stock Number. The part number can be ascertained to be correct by reference to the appropriate Illustrated Parts Breakdown (IPB), and the National Stock Number may be obtained by reference to the appropriate Consolidated Master Cross-Reference List (C-MCRL). It should be remembered that part numbers may be duplicated by various manufacturers; therefore, the Federal Supply Code for manufacturers must be considered when cross-referencing a part number to the NSN.

Drawing Number

A drawing number consists of letters or numbers, or a combination of letters and numbers, which are assigned to a particular drawing for identification purposes. The activity controlling the drawing (normally the manufacturer) assigns the number in conformance with their drawing numbering system. One drawing may apply to several items; thus, other distinguishing data may be necessary to identify the item on the drawing.

Drawing numbers may be used to identify the microfilm available on some support equipment and kept in many technical libraries. Some large assemblies are illustrated in IPBs but are not broken down sufficiently to show identifying data for their component parts. By obtaining the drawing number of the larger item and cross-referencing it to the applicable microfilm, sufficient identifying information for the component part may be obtained.

Specification Number

Specification numbers are assigned to documents describing the characteristics and the

properties of material purchased by the Federal Government. These specifications are used by purchasing officers to ensure that all the requirements for the material are met. Specification numbers are particularly useful on some support equipment in trying to procure component parts.

Nameplate

Some equipments have nameplates attached which provide such information as the manufacturer's name or code, make or model number, serial number, size, voltage, phase, NSN, etc. This is particularly helpful when requesting material not subject to the Federal Catalog System.

Marking and Measurements

Special coded markings (other than part numbers) and measurements often aid in the identification of some materials.

MANUFACTURERS' INSTRUCTION BOOKS

Most AV equipment purchased by the Navy is covered by instruction books or technical manuals published by the manufacturers. You will use these books occasionally as an aid to material identification since they often include parts lists and detailed drawings and specifications.

ILLUSTRATED PARTS BREAKDOWN

Illustrated Parts Breakdown (IPB) publications are an important source of information necessary to order specific support equipment parts. Properly used, they will provide reference information necessary to identify a part number to the specific model of equipment and in some cases provide interchangeability data that can be utilized when the prime item requested is not in stock.

An Illustrated Parts Breakdown is prepared by the manufacturer for most major items of AV equipment and accessories. The IPB is designed to enable supply and maintenance personnel to identify and order replacement parts for equipment. Procurable assemblies and detail parts are illustrated and listed in such a manner as to make possible quick identification of assemblies and their component parts. The items are arranged continuously in assembly breakdown order with the illustrations placed as near as possible to their appropriate listing.

Although slight variations in format exist among the various IPBs, each usually includes the following major sections:

The INTRODUCTION includes general information about the equipment, contents of the publication, and instructions for its use. The introduction should be referred to prior to using an unfamiliar IPB.

The GROUP ASSEMBLY PARTS LIST consists of a breakdown of the complete unit into major components, systems, installations, assemblies, and detail parts. Generally, parts are indexed in disassembly order. In some instances, assemblies or installations are shown in assembled form in one figure and the detail parts are illustrated in another figure.

The NUMERICAL INDEX lists part numbers in alphanumerical order, and each part number is cross-referenced to the figure and index number where it is illustrated. This section also shows the total quantity of each part used in the equipment, material source code, and National Stock Number when applicable.

The REFERENCE DESIGNATION INDEX lists, in alphanumerical order, reference designators (example: B1, J1, K7, etc.) symbols on drawings and wiring diagrams. The index also lists part numbers and index numbers of where the parts are located in the IPB.

CONSOLIDATED MASTER CROSS-REFERENCE LIST

The Consolidated Master Cross-Reference List CRL is designed to provide a cross-reference from a reference number such as a manufacturer's part number, a drawing number, a design control number, etc., to its assigned National Stock Number (NSN), (Part I), and from NSN to reference number, (Part II), to assist in identifying items in the supply system. It includes items of supply which are utilized by all services; therefore, many NSNs will be identified in the CRL which are not listed in the Navy Management List.

The format of Part I of the CRL is shown here. The information presented in each column is as follows:

COLUMN TITLE	DATA PRINTED
Reference No.	A number, other than an activity stock number, used to identify an item of production.
Mfr. Code	The applicable manufacturer's assigned five-digit code as listed in the Cataloging Handbook H4-2.
RNVC (Reference Number Variation Code)	A code indicating whether the reference number is item-identifying or requires additional data to correctly identify the item of supply.
National Stock No.	The NSN assigned to the reference number.

The Reference Number Variation Code (RNVC) column indicates, by use of the numbers 1, 2, 3, and 9, those items that require supplementary data to fully identify them. These codes are as follows:

Code 1—Nonidentifying	—The reference number does not completely identify the item. When cited, it must be accompanied by additional descriptive data such as color, length, rating, etc.
Code 2—Identifying	—The reference number in company with the Federal Supply Code for Manufacturers (FSCM) completely and uniquely identifies the item of supply. Code 2 items may also have nonidentifying reference numbers.
Code 3	—The reference number is a vendor's number on a Source Control Item.
Code 9	—This code is used to indicate (1) reference number is for information only, (2) reference number or specification is obsolete or superseded.

Part II of the CRL presents the same data in NIIN sequence.

OBTAINING MATERIAL

Once you have found the stock numbers, you are ready to requisition your supplies. Most material is obtained by requisition, but purchase is used to procure nonstandard material and to meet emergency requirements. The simplest form of a requisition is merely a request for material made out on the appropriate Navy form and drawn at a naval supply activity. In the event that material is required to be obtained by open purchase to fill specialized needs, this also is usually handled by the local supply division or activity.

Two requisitions forms are used to order supplies and services: the DD Form 1348 and DD Form 1149. Under certain circumstances, requisitions may be submitted by message or letter. Normally, requisitions are submitted on the DOD Single Line Item Requisition System Document, DD Form 1348. However, the DD Form 1149 may be used for certain material or services.

In the preparation and use of the DD Form 1348, you must be familiar with certain terms, and the systems that govern the form's use—Military Standard Requisitioning and Issue Procedures (MILSTRIP), and Uniform Material Movement and Issue Priority System (UMMIPS).

MILSTRIP

The Military Standard Requisitioning and Issue Procedures (MILSTRIP) system provides a common language for requesting and supplying material within and among the Army, Navy, Air Force, Marine Corps, and the General Services Administration (GSA), and it provides a requisition document (the DD Form 1348) that can be processed by electronic accounting machine/automatic data processing (EAM/ADP) equipment and contains all information necessary to issue, ship, and account for the requested material.

Some of the common terms in the "common language" of MILSTRIP are:

BACKORDER—A requisition that cannot be filled by the supply activity from current stock and is being held until additional stock is received, at which time the issue will be made.

MATERIAL OBLIGATION VALIDATION (MOV) REQUEST—A request from a supply source to a requisitioner for a comparison of requisitions held on backorder by the supply source with those carried as outstanding by the requisitioner.

REFERENCE NO.	MFR CODE	RN VC	NATIONAL STOCK NO.
55599	62983	2	4320-00-057-0782
556	24161	2	3030-00-269-9669
556-012-001	16665	2	5950-00-237-7237
556-1137	46859	2	5841-00-323-0747
556-1182	46859	2	5365-00-323-0749
556-2332	46859	2	5305-00-433-9273
556-35-1246FW160P 2	01351	2	3020-00-967-4607
556-3541	46859	2	5365-00-514-0363
556-3541-1	46859	2	5365-00-200-5226
556-3936	46859	2	3020-00-093-6898
556-5505	46859	2	3020-00-036-8447
556-6539	46859	2	5365-00-546-2346
556-8804	46859	2	3110-00-198-1007
556DB20W035B55	00853	2	5910-00-490-7941
556D008G16	79500	2	5977-00-983-1330
556D008G18	79500	2	5977-00-495-6757
556DGAX2-20H	30760	2	4320-00-595-0790
5560	72149	2	5950-00-647-5926
5560-15	79136	2	5365-00-916-4521
55600	43334	2	3110-00-542-1673
55600XR1B	43334	2	3110-00-542-1673
556001-548	12436	2	5935-00-054-4244
556002-129	16665	2	5935-00-451-3179
556012-022	16665	2	5950-00-826-5827

Columns of the Consolidated Master Cross-Reference List, Part 1.

MATERIAL OBLIGATION VALIDATION (MOV) RESPONSE—Reply by a requisitioner to a MOV request advising the supplier to: Hold a backorder until supplied; Cancel a backorder; Reduce the quantity.

CANCELLATION—A total or partial discontinuance of supply action requested by the requisitioner and confirmed by the supplier.

CHARGEABLE ACTIVITY—The activity for which the expenditure represents a cost of operation regardless of the funds used.

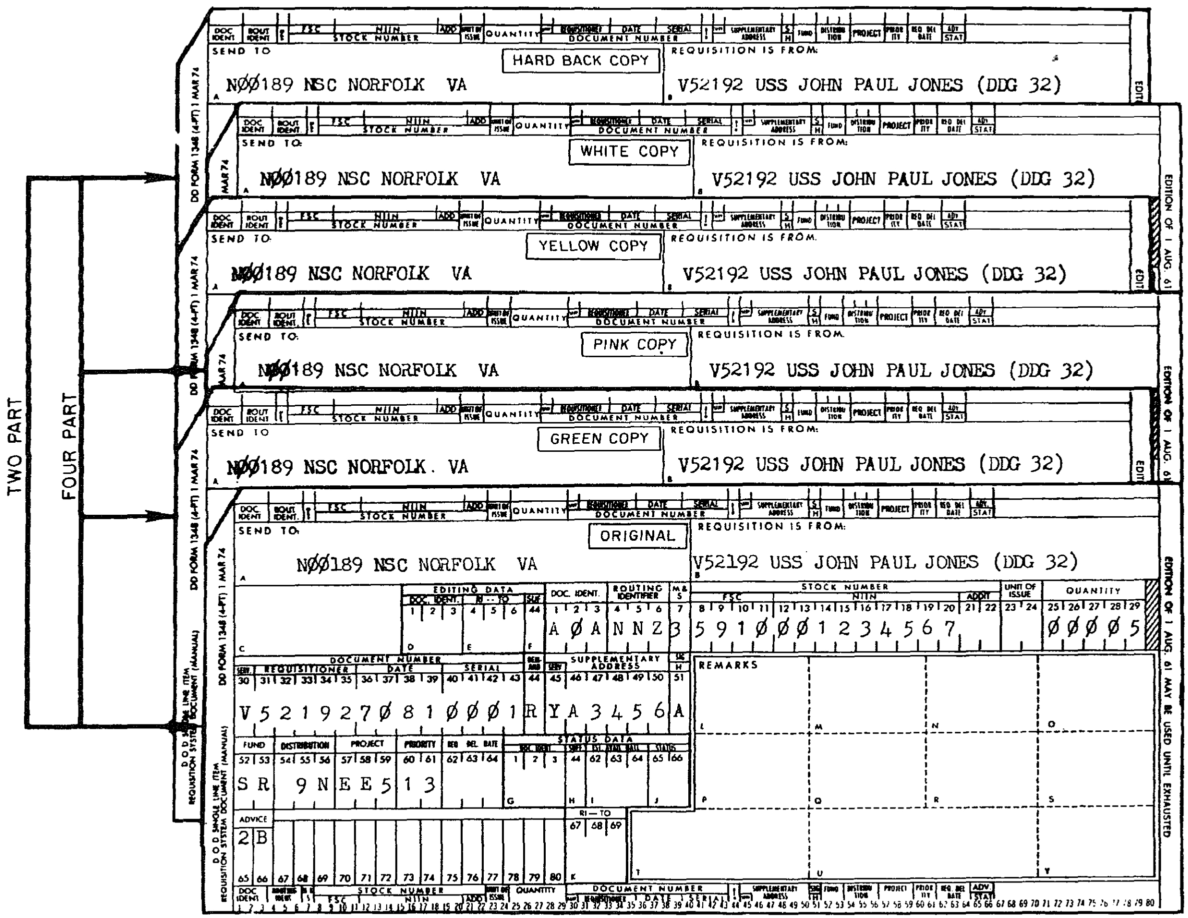
EXCEPTION STATUS—Any supply action other than issue of material in the quantity requested.

FOLLOWUP—An inquiry by the requisitioner to the last known holder of a requisition as to the action taken on that requisition.

FOLLOWUP REPLY—Current status by the holder of the requisition in response to a followup.

FORCE/ACTIVITY DESIGNATOR (F/AD)—A Roman numeral designator established by each military service or the Joint Chiefs of Staff which relates to the military mission of the force or activity.

OUTSTANDING REQUISITION—A requisition for which all requested material has not been received.



DOD Single Line Item Requisition System Document (Manual), (2-, 4-, and 6-part form), DD Form 1348.

STANDARD DELIVERY DATE (SDD)—The standard delivery date is based on the priority designator in the requisition, and is the latest date by which the supply system normally is expected to make delivery of material to the requisitioner.

REQUISITIONER—Any Navy activity, afloat or ashore with a unit identification code (UIC) assigned to the *NAVCOMPT Manual,* Volume 2, Chapter 5, requisitioning material from a supply source.

SHIPMENT STATUS—Positive advice of shipment indicating date and mode of shipment, including transportation control number or bill of lading number when applicable.

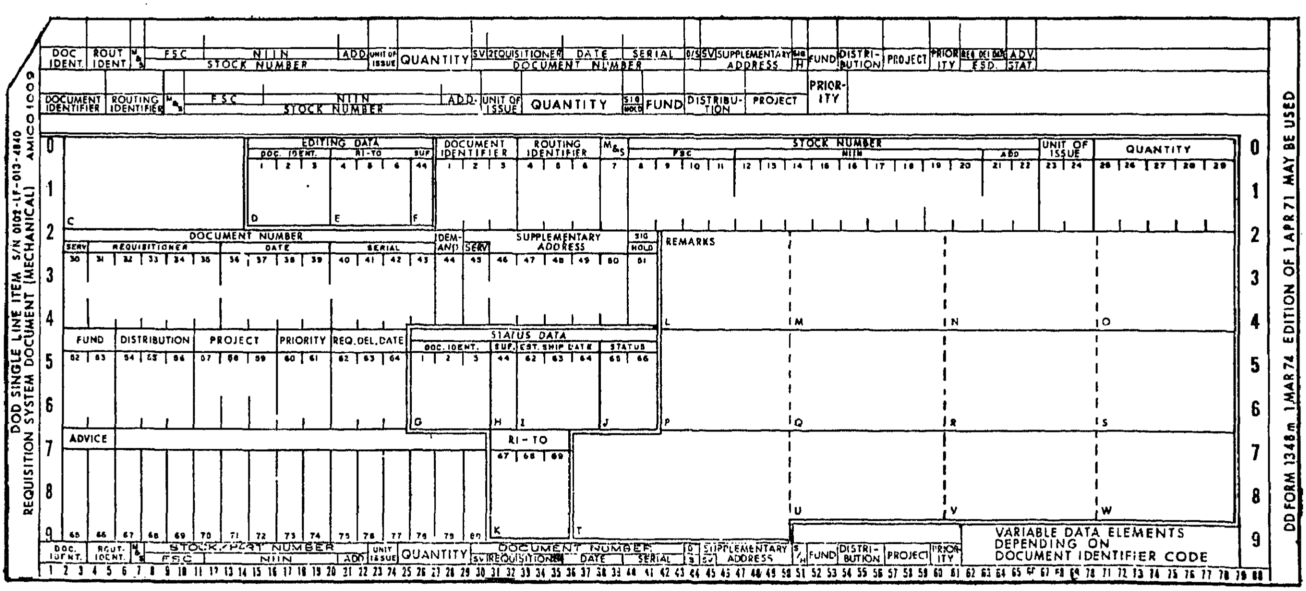
STATUS CODES—Codes used by supply sources to furnish information on the status of requisitions to the requisitioner or consignee.

100% SUPPLY STATUS—Any positive or negative supply distribution decision or action at any level; e.g., any action by the supplier, including issue of material in exact quantity requested.

The DD Form 1348, DOD Single Line Item Requisition System Document is available as 2-part, 4-part, or 6-part forms for manual use or a single card form for mechanized use. All copies of the manual forms are identical except for data blocks T and U. These blocks are blank on the original, but the copies are printed to provide a place to show the unit and total price. The mechanized form is basically the same as the manual, except that data blocks A and B are omitted.

You can readily see the extensive use of codes in MILSTRIP requisitioning. This is necessary because only 80 alphabetic and/or numeric characters (letters and numbers) can be placed on the card (this does not include the activity names shown in data blocks A and B). It is essential for you to select the correct code to convey the proper information to the supplier. The correct codes are just as important on a requisition as the correct NSN.

Make out your DD Form 1348 with a typewriter or ballpoint pen. Do not use a pencil, because pencil marks can smudge and cause errors when the requisition is processed through mark-sensing equipment. In preparing requisitions it is not necessary to space the entries within the "tic" marks printed on the forms, but you must get each entry inside the proper data blocks. To eliminate any possible confusion between the numeric zero and an alphabetic "O," the communication zero (Ø) is used on MILSTRIP requisitions.



DD Form 1348m (Mechanical).

Most material requirements are requisitioned on DD Form 1348. However, certain items are excluded from MILSTRIP and are ordered on DD Form 1149.

UMMIPS

The Uniform Material Movement and Issue Priority System (UMMIPS) is a vital and integral part of the MILSTRIP system. MILSTRIP provides forms and procedures for requisitioning material and UMMIPS provides the method of assigning priorities for the issuing and movement of material. UMMIPS ensures that material issue requests are processed in accordance with the military IMPORTANCE of the requiring activity and the URGENCY of that activity's needs. In the movement and issue of material it is necessary to provide a common basis to identify the relative importance of completing demands for logistics systems resources, such as transportation, warehousing, introduction of requisitions for processing, and material assets. The relative importance and urgency of logistics requirements is indicated by two-digit issue priority designators.

Force/Activity Designator

A Force/Activity Designator (F/AD) is a Roman numeral (I thru V) which identifies and categorizes a force or activity on the basis of its military importance. The assignment of F/ADs is shown in NAVSUP P-485.

Urgency of Need Designator

The Urgency of Need Designator (UND) is an uppercase letter of the alphabet (A, B, or C) selected to indicate the relative urgency of a force or activity's need for a required item of material. Assignment of UNDs is the responsibility of the force or activity requiring the material.

UND	Definition
A	Requirement is immediate. Without the material needed, the activity is unable to perform one or more of its primary missions.
B	Requirement is immediate, or it is known that such requirement will occur in the immediate future. The activity's ability to perform one or more of its primary missions will be impaired until the material is received.
C	Requirement is routine.

F/AD AND UNDs PRIORITY DESIGNATORS					
URGENCY OF NEED DESIGNATOR	F/AD				
	I	II	III	IV	V
	PRIORITY DESIGNATOR				
A (UNABLE TO PERFORM)	01	02	03	07	08
B (PERFORMANCE IMPAIRED)	04	05	06	09	10
C (ROUTINE)	11	12	13	14	15

Issue Priority Designator

The Issue Priority Designator (IPD) is a two-digit number (Ø1—highest to 15—lowest) determined by using the table of priority designators.

For example, if your ship is assigned an F/AD of III and your requirement is of a routine nature, the priority to be assigned would be 13.

In addition to providing standardized criteria for assigning priorities, UMMIPS provides acceptable maximum processing times for use by supply activities in furnishing material. Processing time standards and additional codes used in MILSTRIP and UMMIPS are included in NAVSUP P-485.

PROCUREMENT PROCEDURES

There are a number of sources of information for filling out the DD Form 1348, but to ensure you have access to those procedures, we have included the basic process in Appendix III of this text.

Several publications are available either in your unit or your servicing supply department to give specific procedures and notices regarding the supply system.

Naval Supply Systems Command Publication 437

The NAVSUP P-437 promulgates policy and procedures relative to the Military Standard Requisitioning and Issue Procedure and the Military Standard Transaction Reporting and Accounting Procedures (MILSTRIP/MILSTRAP). This publication covers MILSTRIP/MILSTRAP relative to supply system management, requisitioning ashore, inventory control, financial matters, material movement, priorities, and evaluation procedures. This publication provides forms, formats, codes, and serves as a comprehensive ready reference for those involved in the preparation and/or processing of MILSTRIP documents.

NAVSUP P-437 is not distributed afloat. All afloat MILSTRIP/MILSTRAP are incorporated into the NAVSUP P-485.

MILSTRIP/MILSTRAP

Desk Guide (NAVSUP P-409)

Since NAVSUP P-437 is a comprehensive publication, filling three 2-inch binders, the MILSTRIP/MILSTRAP Desk Guide, NAVSUP P-409, is published to serve as a handy reference for originating and processing MILSTRIP and MILSTRAP documents. This small booklet contains those common definitions, coding structures, and abbreviated code definitions used on a day-to-day basis.

Fleet Use of MILSTRIP (NAVSUP P-410)

NAVSUP P-410 serves the same purpose as the Desk Guide (NAVSUP P-409) and is for use by fleet personnel. In addition, it is designed to be used for indoctrination and training of fleet personnel in MILSTRIP.

DD Form 1149

The Requisition and Invoice/Shipping Document, DD Form 1149, is used as the procurement document for the items excluded from MILSTRIP. These items are listed in the NAVSUP P-485.

A requisition on the DD Form 1149 is limited to a single page and must be prepared with a typewriter or ballpoint pen.

The requisition number and priority are assigned in the same manner as for the MILSTRIP requisition. However, when more than one item is being ordered, only the UIC and Julian date are shown in data block 6. A separate

SHIPPING CONTAINER TALLY → 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

REQUISITION AND INVOICE/SHIPPING DOCUMENT

SHEET NO. 1	NO. OF SHEETS 1	5. REQUISITION DATE 15 OCT 197–	6. REQUISITION NUMBER R52192-4288
7. DATE MATERIAL REQUIRED 30 OCT 197–			8. PRIORITY 13

1. FROM. R52192 USS JOHN PAUL JONES (DDG 32)

2. TO N00244 NSC SAN DIEGO, CA

9. AUTHORITY OR PURPOSE

10. SIGNATURE I.L. Garner
I.L. GARNER, LT, SC, USN

11a. VOUCHER NUMBER AND DATE

b

3. SHIP TO · MARK FOR
SUPPLY OFFICER
USS JOHN PAUL JONES (DDG 32)
PIER 2, NAVSTA, SAN DIEGO, CA.

12. DATE SHIPPED

13. MODE OF SHIPMENT

14. BILL OF LADING NUMBER

15. AIR MOVEMENT DESIGNATOR OR PORT REFERENCE NO.

4. APPROPRIATION AND SUBHEAD	OBJ CL	BUR CONT NO	SUBAL-LOT	AUTHORIZATION ACCT'G ACTIVITY	TRANS. TYPE	PROPERTY ACCT'G ACTIVITY	COUN-TRY	COST CODE	AMOUNT
FUND CODE NU									

ITEM NO (a)	FEDERAL STOCK NUMBER, DESCRIPTION, AND CODING OF MATERIAL AND/OR SERVICES (b)	UNIT OF ISSUE (c)	QUANTITY REQUESTED (d)	SUPPLY ACTION (e)	TYPE CON-TAINER (f)	CON-TAINER NOS. (g)	UNIT PRICE (h)	TOTAL COST (i)
	SERVICES AND MATERIAL FOR REPAIR OF:							
	3001 MARCHANT CALCULATORS, Ser. Nos. 441067, 441255	JOB	1					
	3002 FRIDEN ADDING MACHINE, Ser. No. 56432	JOB	1					
	3003 IBM ELECTRIC TYPEWRITERS, Ser. Nos. 14-367421, 15-667441	JOB	1					
	3004 REMINGTON ELECTRIC TYPEWRITER, Ser. No. 336601	JOB	1					

16 TRANSPORTATION VIA MATS OR MSTS CHARGEABLE TO

17 SPECIAL HANDLING

18 RECAPITULATION OF SHIPMENT	TOTAL CONTAINER	TYPE CON-TAINER	DESCRIPTION	TOTAL WEIGHT	TOTAL CUBE	19. RECEIPT				
ISSUED BY							CONTAINERS RECEIVED EXCEPT AS NOTED	DATE	BY	SHEET TOTAL
CHECKED BY							QUANTITIES RECEIVED EXCEPT AS NOTED	DATE	BY	GRAND TOTAL
PACKED BY			← TOTAL →				POSTED	DATE	BY	20 RECEIVER'S VOUCHER NO

51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

DD FORM 1 MAR 59 1149 (9-PT)

REPLACES EDITION OF 1 MAY 58 WHICH MAY BE USED

S/N 0102-LF-011-1801

ORIGINAL

Requisition and Invoice/Shipping Document, DD Form 1149 (Multiple Requests).

serial number is assigned to each item on the requisition.

SPECIAL REQUISITIONING INFORMATION

Thus far, you have learned how requisitions are prepared and submitted for routine requirements. Not all requisitions, however, are routine. For some, special handling or additional information is required.

SERVMART

SERVMARTS are convenient sources of material that permit the use of a single money value only (MVO) requisition to procure several stock items. SERVMARTS are located at most major naval bases and are arranged in a supermarket concept.

When it is appropriate to obtain material from a SERVMART, an MVO DD Form 1348 is prepared. Each of the following categories of material is listed on a separate DD Form 1348 when SERVMART shopping lists (SSLs) are used:

- Consumable items
- Repair parts
- Equipage

To aid you in preparing requisitions, each SERVMART prepares shopping guides that list items stocked and distributes these guides to ships and activities in the area.

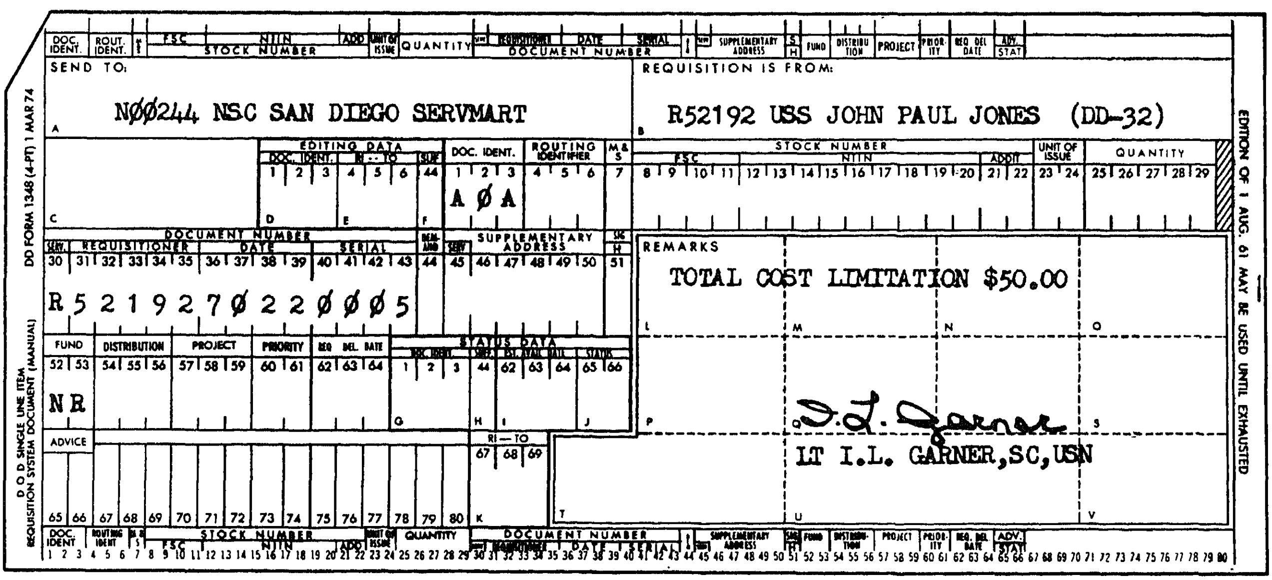
Upon receipt of an internal request, a DD Form 1348 is prepared to cover the money value, and the original is given to the person authorized on the form to pick up the material.

Transfer From Other Ships and Activities

Emergency requirements may be obtained from ships other than supply ships and tenders if the material is available and can be spared. The request may be made on a DD Form 1348 or by message and should contain the same information as a requisition to a supply activity except for the routing identifier which is left blank. If the requested material is not available for issue, the requisition is returned to the requisitioner since ships do not hold requisitions on backorder for later issue.

Forms and Publications

Forms are requisitioned on DD Form 1348 in the same manner as any other consumable material.



Money value only requisition, DD Form 1348.

Publications (identified by cognizance symbol Ø1) are not carried in a stores account and are issued without charge.

Special requisitioning instructions, approval requirements, and restrictions are indicated in the Requisition Restriction (RR) column of the *Navy Stock List of Forms and Publications.*

NAVSUP Form 1205 is used to order Navy departmental directives. There is no cost for these directives. The form is preaddressed to the Naval Publications and Forms Center and may be placed in a window envelope for mailing after it (including the return address label) has been filled out.

Requisition Followup

When material or status has not been received by the standard delivery date (SDD) or the required delivery date (RDD), you may submit a followup to determine the status. The standard delivery date is computed by adding the authorized UMMIPS delivery time to the Julian date of your requisition. The followup may be submitted on DD Form 1348 (2-part).

The document identifier AF1 and the routing identifier for the last known holder of the requisition are assigned. The balance of the followup is identical to the original requisition unless part of the material has already been received.

When taking followup action on a requisition for urgently needed material and for which the SDD or RDD is past with no status received, document identifier AT_ may be used instead of AF1. This tells the supply activity that if they have no record of the original requisition to process the followup as a requisition. This could preclude the need for another requisition if response to an AF1 followup should be "no record of your requisition." However, it may also result in duplicate shipment and billing.

Requisition Cancellation

When material, not delivered, is no longer required, you should send a cancellation request to the last known holder of the requisition. It is prepared in the same manner as a followup except that a document identifier in the AC __ series is used. Submission of a cancellation request does not guarantee cancellation of the requisition. If the supply activity has already released or shipped the material, the requisition cannot be canceled. For this reason, you should not consider a requisition canceled until confirmation is received from the supply activity.

Purchase

Purchase actions are normally taken by a shore activity as a result of emergency requirements for supplies or services by purchase on the open market when all of the following conditions exist:

- There is an immediate and urgent requirement for authorized supplies or services.

- The supplies or services are not available at the local supply support activity.

- Time is of the essence and scheduled operations will not permit procurement through the regular Navy Supply System.

When authorized, the supply officer may make routine purchases of supplies and services when all of the following conditions exist:

- The supplies or services are not available at the local supply support activity.

- Supply department resources are sufficient to handle the additional workload involved without detrimental effects.

- The supply officer is reasonably familiar with the local market area.

- All transactions are made by an approved small purchase method providing for immediate delivery of the material purchased.

METHODS OF PURCHASE.—Purchases are made by one of the following methods:

- Purchase order for purchases not in excess of $2500.

- Imprest fund for cash purchases when the amount does not exceed $150 ($300 under emergency conditions).

- Orders under indefinite delivery-type contracts and blanket purchase agreements (BPAs) that have been negotiated by ashore activities.

DEPARTMENT OF THE NAVY
NAVAL PUBLICATIONS AND FORMS CENTER
5801 Tabor Ave.
Philadelphia, Pa. 19120
OFFICIAL BUSINESS
Penalty for Private Use $300

POSTAGE AND FEES PAID
DEPARTMENT OF THE NAVY
DOD-316

U.S.MAIL

REQUISITION NUMBER *(For Local Convenience)*

INSTRUCTIONS

This form is for use in requisitioning NAVY departmental directives. CLASSIFIED directives must be ordered on a separate requisition. A window envelope may be used.

Name and address of requisitioning activity MUST be typed on label at top of page when form is prepared.

Order Notices directly from originator(s).

ITEM NO.	BUREAU OR OFFICE AND DIRECTIVE NO. *(List, by orig'g office, in numerical sequence)*	QTY.

TO: COMMANDING OFFICER
NAVAL PUBLICATIONS AND FORMS CENTER
5801 TABOR AVENUE
PHILADELPHIA, PA. 19120

DATE

DEPARTMENTAL-DIRECTIVES REQUISITION — NAVSUP FORM 1205 (Rev. 8-73) *0108-LF-503-7704*

A single requirement may NOT be divided into more than one purchase action for the purpose of avoiding the monetary limitations stated above.

Procedures for purchases by ashore activities are provided in NAVSUP P-467.

> IMPREST* FUNDS
>
> The imprest fund is a simple and economic method of making purchases of $150 ($300 under emergency conditions) or less. It is a cash fund and operates much like the petty cash fund used by private industry. It is, in effect, a miniature revolving fund. The fund is reduced as purchases are made. When the reimbursement voucher is prepared, the ship's OPTAR is charged for the amount spent and the money returned to the imprest fund.
>
> **An advance or loan.*

AUDIOVISUAL EQUIPMENT AND MATERIAL

You might think of your storekeeper work as being a circle formed by a chain with each link representing a specific job. Each link is dependent on all the others just as there is a relationship between all Photographer's Mates' jobs. If the procurement documents were properly prepared, the receiving procedure will be relatively simple. As the "storekeeper" for the AV facility, you will be responsible for the receipt, identification, inspection, and distribution of incoming supplies and equipment. Two terms you should understand in your work as the AV supply PO are accountability and custody.

Accountability here refers to the accountability for plant property and the accountability required for photographic and audiovisual material. You may be required to aid in accounting for all such Navy-owned property held by your activity. It is the AV manager's or officer's responsibility to maintain property records for all accountable property issued to the photo lab or AV unit. Guidelines and instructions concerning accountability and disposition of audiovisual equipment can be found in OPNAVINST 10700.1.

The term "custody" means the responsibility for proper care, stowage, use, and records of Navy material. The audiovisual manager or officer is responsible for all supplies carried in an AV facility. When the supplies are stowed in the storerooms, the AV officer is said to have technical custody of the material. As the supply PO, you will have actual custody; i.e., physical custody of the material. As such you are the custodian of the material in the storeroom and are responsible to the AV manager or officer for its safekeeping.

PLANT PROPERTY

"Plant Property" is the term used in the Navy to describe all Navy-owned real property, and other property under the care of the Navy.

All plant property items are divided into four classes as follows: Class 1—land; Class 2—buildings and improvements; Class 3—equipment (other than industrial production equipment); and Class 4—industrial production equipment.

As a Photographer's Mate, you will be most concerned with Class 3—equipment. Examples of this type of equipment in a photo lab would be typewriters, adding machines, and enlargers. Custody records must be maintained for this material throughout its in-use life.

AUDIOVISUAL EQUIPMENT INVENTORY REPORT

Chief of Naval Operations instructions, OPNAVINST 5290.1 contains specific guidelines and instructions concerning the accountability, disposition, and inventory control of audiovisual equipment. They assign to the Commander, Naval Air Systems Command, the responsibility of inventory manager for photographic equipment, including its development, procurement, allocation, and control.

So that NAVAIRSYSCOM can effectively manage AV supplies and equipment, and to ensure that AV facilities both ashore and afloat are properly equipped, the Navy Audiovisual Equipment Inventory Report procedures must be followed. Detailed procedures for preparing this report are given in OPNAVINST 5290.1.

STOWAGE

The supply PO is responsible for proper stowage of materials to protect them from damage and deterioration while in storage.

Materials in both shipboard and ashore AV storerooms should be arranged to:

- Ensure maximum utilization of available space.
- Provide orderly stowage and ready accessibility.
- Prevent damage to the ship, facility, or injury to personnel.
- Reduce the possibility of material loss or damage.
- Facilitate issues and inventories.

Storeroom Layout

To the maximum extent that available space permits, you should adhere to the following guidelines when stowing AV supplies and equipment.

- Locate heavy bulk materials in areas most convenient to hatches and doors and materials-handling equipment to minimize the physical effort required for loading, stowage, and breakouts.
- Locate light bulky material in storerooms with high overhead clearances for maximum use of available space.
- Segregate materials which are dissimilar in type or classification (e.g., hazardous/non-hazardous, classified/unclassified, large/small).
- Locate frequently requested material as close as possible to the point of issue.
- Locate shelf-life items (film, paper, etc.) in a readily accessible area to facilitate periodic screening.
- Provide for aisles at least 30 inches wide between bins, racks, and/or cabinets.
- Arrange materials with identification labels facing outward to facilitate issues and inventory.
- Avoid multiple locations for the same item.

Hazardous Material

Hazardous material includes all types of compressed gases, acids, paint, and materials which present a considerable fire hazard or are otherwise dangerous. Except as provided below, these materials must be stowed in paint and flammable liquid storerooms.

COMPRESSED GASES.—Compressed gases must be stowed on the weather deck or outdoors and securely fastened in a vertical position. The cylinder valves should be protected from accumulations of ice and snow, and the cylinders should be screened from direct rays of the sun.

ACID.—Liquid acid, unless classified as safe material, should be stowed in lead-lined boxes.

Security

Storerooms should be locked when not in use. Ordinarily, only the supply PO in charge of a storeroom and his assistants will have access to the storeroom, and one of them must be present when the storeroom is open. Other persons may be admitted when necessary during receipt or issue of stores.

Access must be given to damage control and fire department personnel in the performance of their duties, and storerooms must be secured in such a way as to permit emergency entrance with ordinary damage control and emergency equipment.

STOCK CONTROL

The prime function of stock control is to ensure the availability of materials in the proper amount, at the proper place, and at the proper time. To accomplish this end, continuous and judicious management of materials must be exercised.

Records must be properly maintained to ensure the accountability of materials, to provide a ready reference for determining the stock

position, and for reports reflecting accurate information to the Navy inventory managers to provide for future support.

STOCK RECORD CARDS

As a photographer, you will be concerned with several stock record forms for establishing and maintaining a stock record for each item carried by your AV activity. Four of the forms you may use are:

- Stock Record Card (NAVSUP Form 766)
- Stock Record Card Insert (NAVSUP Form 768)
- Stock Status and Replenishment Card (NAVSUP Form 767)
- Stock Record Card Afloat (NAVSUP Form 114 (Manual))

A Stock Record Card (NAVSUP Form 766) is the official record of all receipt and expenditure transactions and contains the current stock balance of each item carried in stock. All receipts, expenditures, inventory adjustments, and demands are entered on the stock record card.

A stock record card contains the following information:

- Stock number of material: This can be located in the *Management List-Navy*, *Master Repairable Item List*, *Afloat Shopping Guide*, *Consolidated Master Cross-Reference List*, *GSA Catalog*, *Navy Stock List of Publications and Forms*, etc.

- Card No: The initial card for *each* item is card number "1" with each new card for the same item numbered consecutively.

- Date: The Julian date on which the material is issued or received.

STOCK NO. 9G6750-00-986-0480 CARD NO. 01

JULIAN DATE	DOCUMENT NO.—RECEIVED FROM/ISSUED TO RECEIPTS RED/ISSUES BLACK	REPORTABLE DEMAND	OTHER ISSUES/REC'TS	BALANCE	JULIAN DATE	DOCUMENT NO.—RECEIVED FROM/ISSUED TO RECEIPTS RED/ISSUES BLACK	REPORTABLE DEMAND	OTHER ISSUES/REC'TS	BALANCE
	BAL. FWD FROM CARD NO. ______								
8198	NSC Norva		48	48					
8204			12	36					
8221			2	34					
8301	NSC Norva		120	154					
8321			27	127					
					BALANCE CARRIED TO REVERSE SIDE				

STOCK RECORD CARD — NAVSUP FORM 766 (REV. 12-62) S/N 0108-LF-502-0002 ☆GPO 1978—O—709-970

9G6750-00-986-0480

- Document number: The requisition number or invoice number under which the material was received.

- Received from/Issued to: All receipts are entered in red ink; all issues entered in black ink.

- Reportable demand: The quantity expended requiring replacement for continued operations.

- Other issues/Rec'ts: Nonreplenishment issues and receipts for example items that are not consumable.

- Balance: The amount remaining after issues and receipts have been accounted for.

A Stock Record Card Insert (NAVSUP Form 768) contains the identifying information of stock items and serves as an index to the Stock Record Card. All information necessary for filling in the card can be found in the various publications mentioned earlier.

A Stock Status and Replenishment Card (NAVSUP Form 767) maintained for each item in stock serves a dual purpose. The left side of the card is used to assemble stock status data preparatory to replenishment action and serves as a historical record of such data. The right portion of the card is divided into two sections: ordered and received. It serves as a record of replenishment actions and shows the status of all expected receipts.

A Stock Status and Replenishment Card contains the following information on the left side:

- Stock number: Obtained in the same manner as the stock number on the stock record card.

- Account: Either APA or NSA as appropriate.

- Card number: Obtained in the same manner as indicated for a stock record card.

- Replenishable period ending: The end of the quarter. The upper number indicates the number of the week, the lower number the year.

- Reportable demand: The replenishment demand or amount expended for the preceding period.

- Total outstanding obligations: Definite obligations for supplying other activities; definite obligations needed for an increase in workload.

- Planned requirement: Estimated amounts needed to supply other activities; estimated amounts needed for a predicted increase in workload.

- Balance on hand: The amount left in stock after issues.

- Expected receipts due: Items that are on order.

	UNIT	UNIT PRICE	LOCATION BUILDING	FLOOR LEVEL	BAY	BIN OR SHELF	LOW LIMIT

PACKAGING	SUBSTITUTES
DESCRIPTION	ITEMS INTERCHANGEABLE WITH

OBL	COG.	STOCK NUMBER	NOMENCLATURE	EXHAUSTED	LOW LIMIT	ORDERED	EXCESS	NEW	UNIT	UNIT PRICE	OBL

TABULATING MACHINE USERS PLEASE NOTE-Print cognizance letter, stock number, and nomenclature in sequence indicated.

STOCK RECORD CARD INSERT NAVSUP FORM 768(1C) (REV 2-60) (4410) S/N 0108-LF-502-0302

● Required or excess: Amount to order; amount in excess of that which is needed (any excess amount is circled). To determine the amount of excess or required material the following method can be utilized:

1. Determine the amount that will be required for the next quarter. Add the reportable demand to the total outstanding obligations.

2. Add the balance on hand to the expected receipts.

3. Determine the amount by subtracting the second total from the first total. If the second total is greater than the first total, there is an excess and material will not be ordered.

The following information is provided on the right side (Status of Expected Receipts, **Ordered**):

● Date: The Julian date that the requisition was submitted.

● Expected Receipt Document No: The requisition number of the item on order.

● Quantity: The amount ordered.

The following information is provided on the right side (Status of Expected Receipts, **Received**):

● Date: Julian date that the material was received.

● Receipt document: If different from ordered receipt document number.

● Quantity: If different from ordered quantity.

● Balance on order: Amount not yet received. (In case the order has been cut or split there are four lines per order for this purpose.)

STOCK NO. 1RM1650-00-232-4114AA
ACCOUNT NSA CARD NO. 2

STOCK STATUS DATA							STATUS OF EXPECTED RECEIPTS						
							ORDERED			RECEIVED			
REP. PER'D ENDING	REPT'BLE DEMAND	TOTAL OUTSTAND. OBL'NS	PLANNED REQ MTS	BALANCE ON HAND	EXPECTED RECEIPTS DUE	REQUIRED OR EXCESS	DATE	EXPECTED REC'PT DOC. NO.	QUANTITY	DATE	RECEIPT DOC.	QUANTITY	BAL. ON ORDER
16/82	16	0	0	20	0	28	2316	6007	28	2363		28	—
29/82	14	0	0	34	0	8	2042	9010	8	2110		8	—
42/82	20	0	0	14	8	38	2140	2100	38	2210		8	30
										2225		30	—
3/83	26	4	0	0	38	44	3235	3004	44				
16/83	42	6	44	0	44	132							

STOCK STATUS AND REPLENISHMENT CARD (4442)
NAVSUP Form 767 Rev. (8-60)

882 - REMINGTON RAND II DIVISION OF SPERRY RAND CORPORATION 131 KP 20801
STOCK NO.—0108-502-0102

Stock Status and Replenishment Card (NAVSUP Form 767).

with and under, the Stock Record Card for a particular item.

A Stock Record Card Afloat (NAVSUP Form 1114 (Manual)) is maintained on board ships operating under manual stock control procedures. NAVSUP Form 1114 (Manual) may be prepared by hand or by typewriter in accordance with the format printed on the form. Identifying information is inserted on the top and bottom lines of the form.

The Stock Record Card Afloat provides for the recording of replenishment actions, material receipts, and material expenditures and reflects a running balance of the stock on hand.

As requisitions are prepared, they are posted to the "requisitions outstanding" block of the NAVSUP Form 1114 (Manual). The Julian date of the requisition, the document number, and the quantity ordered are entered in the appropriate columns.

High and Low Limits

In order to ensure that your unit has, at all times, a well rounded stock of material necessary to sustain operations for a maximum period of time, effective stock management must be maintained for all your items of stock.

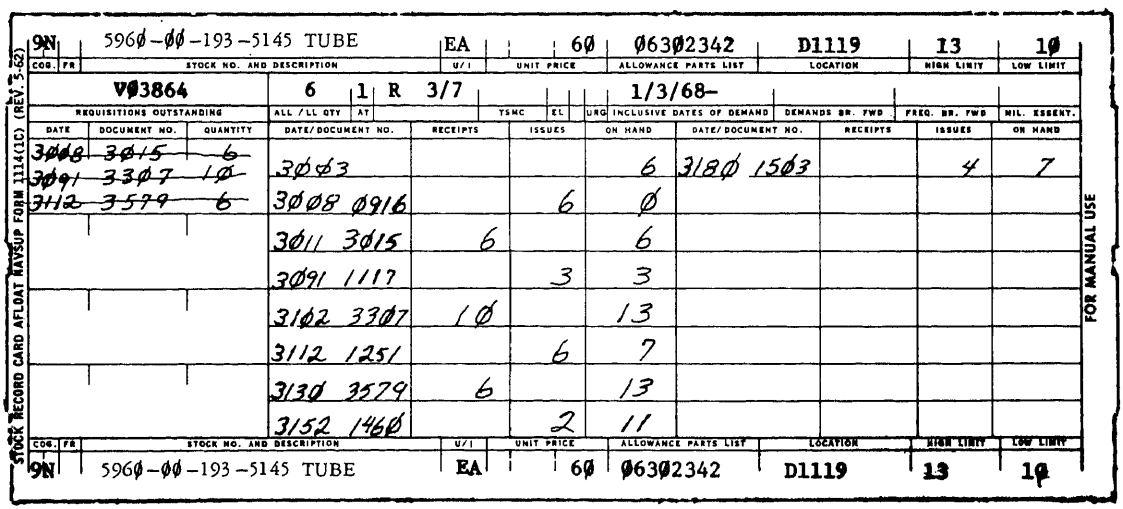
The terms "high and low limits" apply to quantity entries on the stock record cards to mission.

The high limit of a stock item is synonymous with the requisitioning objective; that is, the safety level, plus the operating level, plus the quantity which would normally be required during the ordering and shipping time. A high limit is not assigned to items of stock in quantities of two or less.

The low limit of a stock item is the safety level plus the quantity of material expected to be consumed during the order and shipping time. The low limit entry for all items in which stock is maintained at two or less is the quantity, and replenishment is initiated each time an issue is made.

Stock Records Replenishment Review

The stock records are reviewed at the time receipts and expenditures are posted. The balance on hand is visually checked against the low limit. Items that are approaching or have reached the low limit are flagged, in the manner determined locally, to indicate that replenishment is required at the first opportunity. At the earliest possible time, replenishment requisitions are prepared and submitted to the designated supporting supply point. The material should be ordered in sufficient quantities to bring the material on hand and on order up to the high limit.



Stock Record Card Afloat (NAVSUP Form 1114).

Established high and low limits may have to be adjusted from time to time as usage data so indicates. The following table illustrates an example of how high and low limits are determined:

The table used for this example is based on a stock item with a past usage rate of 100 each per month.

Determining Quantity Levels of Supply

Level of Supply	Months	Appropriate Quantity
1. Safety level	2	200
2. Operating level	6	600
3. Stocking objective (1 + 2)	8	800
4. Order and shipping time	1	100
5. Requisitioning level or high limit (3 + 4)	9	900
6. Low limit (1 + 4)	3	300

In addition, when a ship or unit receives orders for deployment, the stock records are reviewed to ensure that all stocks are replenished as near to the high limit as possible.

Particular attention should be paid to stock records of critical items. They should be flagged appropriately to facilitate frequent review and replenishment. The following categories of items are classed as critical relative to replenishment review procedures:

- Fast-moving items having lower safety levels than desired because of stowage limitations or shelf life.

- All items the lack of which would seriously impair operations.

REQUISITION LOGBOOK

The Requisition Logbook accomplishes two purposes: First, it serves as a ready reference for material on order; and second, it serves as a record of material received. This book should contain columns for the requisition number, stock number, nomenclature, quantity ordered, unit price, total cost, date ordered, date received, local supply department requisition number, and amount received. These columns can be varied to meet local needs.

FILES

Files must be maintained for holding documents which relate to prospective material receipts and which, upon receipt of the material, are used to ease the receiving process. Files are also required for holding the documents after they are processed in order to provide records of proof of receipt.

Material Outstanding File

The material outstanding file contains a copy of each procurement document for material and services not yet received. The file also includes, as attachments to individual procurement requests, related documentation such as followups, supply status, and shipping status.

Material Completed File

The material completed file contains a copy of each procurement document which has been removed from the material outstanding file upon receipt of the material or cancellation of a request for material or services, plus a copy of each applicable receipt document.

> Due to the volume of business and numerous customers at any given supply department, matters requiring followup on outstanding requisitions are more efficiently handled if you know the supply requisition number.

INVENTORY

The term "inventory," as used by Photographer's Mates, applies to the total amount of an item physically within the photographic or AV spaces and under the control of the audiovisual manager or officer.

Inventory aboard ship is necessary to ensure that ships have a well-rounded stock of material on board at all times to sustain operations for a maximum period of time. In order to do this,

effective inventory procedures must be maintained for all items in stock. Inventory ashore is equally as important as aboard ship.

Knowing which catalog and requisition form to use is important, but just as important is knowing when to order your supplies. This can be accomplished only by using a definite system or procedure which includes inventories, logbooks, and stock record cards.

The findings of physical inventories serve to verify that the stock records are correct, or lead to their correction if discrepancies are encountered. Briefly, periodic inventories are taken for the following reasons:

- To determine quantities of stock on hand for comparison with stock record card balances.

- To determine the difference between actual physical count and stock record card balances.

- To ascertain the causes of these differences.

- To provide data for planning against recurrence of these differences.

The most important aspect of physical inventory is that it provides a check to ensure that material presumed to be in stock is actually there and is available when needed. The false security created by an erroneous balance on the stock record card is extremely serious. A zero balance, for instance, may be rectified by timely procurement action. However, if the zero balance is unknown, until a demand is presented, a serious delay may be encountered.

> When taking inventory in a storeroom, you must use the correct NSN or the count will be posted to the wrong card. To help prevent errors in inventory and issues, all stock in the storerooms should be marked with the NSN. This may be done by placing a stock tag on the bin or drawer front if only one type of material is stowed therein, by fastening a stock tag to the item, or by writing the NSN on the item with marking pen or other permanent marking. It will take a little time to mark stock properly when it is inventoried or received, but it can save you a lot of time later on.

CUSTODY CARDS

For each item of controlled equipment requiring custody signature, you must have a Controlled-Equipage Custody Record (4442), NAVSUP Form 306 or 460. Both cards are generally referred to merely as "custody cards." The cards are signed, acknowledging custody of the item, by an appropriate authority, usually the AV manager or officer or the department head after they have sighted the item identified on the card. NAVSUP Form 306 is punched to fit into a three-ring binder. NAVSUP Form 460 fits into the pocket of a Cardex File.

The original and at least one copy of the custody card should be prepared for each item of equipment requiring custody signature. The original should be maintained by the supply officer or the department head. If the supply officer maintains the original then it is generally signed by the department head. Most AV units, however, have their original custody cards maintained by the department head and they are signed by the division officers. For plant property (plant account) items requiring custody signature (typewriters, adding machines, etc.) the administrative branch or the comptroller usually keeps the original.

Duplicate copies of custody cards are usually maintained by the AV supply PO for subcustody purposes of the items. When an item of equipment requiring custody signature is issued to a member of the crew it is signed for on the duplicate copy of the custody card. The person receiving the item is, therefore, acknowledging *subcustody* of the item. Those items which are more or less permanently installed, such as enlargers, studio cameras, etc., should be subcustodied to the petty officer in charge of the work section where the equipment is located.

The duplicate or subcustody card is also used to make periodic and required sight inventories of the items. The card is signed by the person conducting the inventory. The original custody card need only be signed once by the person having custody of the item. It need not be signed each time an inventory is conducted. The original custody card is signed by the relieving authority when he initially sights the custody item.

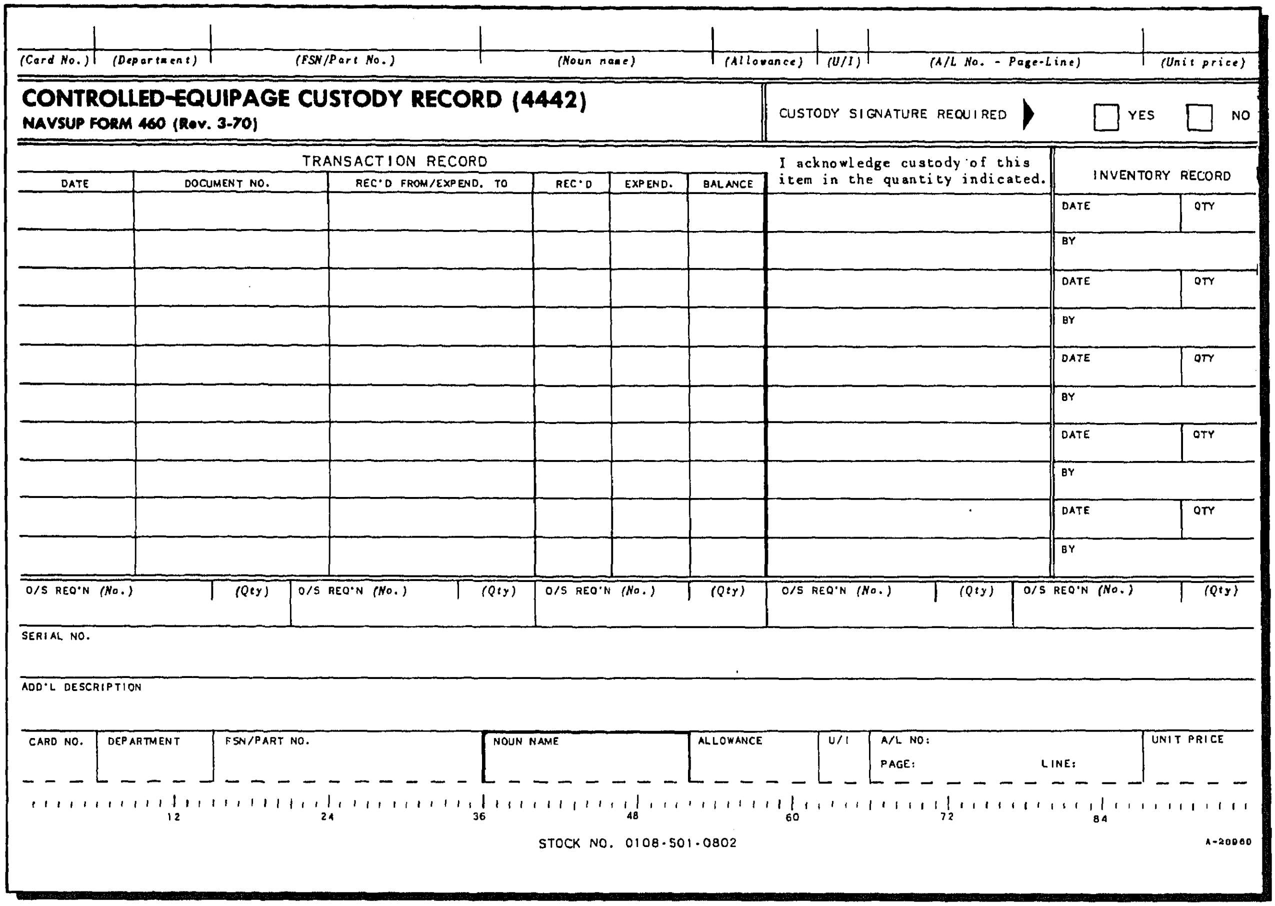
S/N 0108-LF-500-6502 **CONTROLLED-EQUIPAGE CUSTODY RECORD (4442)** NAVSUP FORM 306 (Rev. 1-73)

SERIAL NO.

O/S REQ'N (NO.)	(QTY)	O/S REQ'N (NO.)	(QTY)	O/S REQ'N (NO.)	(QTY)	O/S REQ'N (NO.)	(QTY)	CUSTODY SIGNATURE REQUIRED	☐ YES ☐ NO

TRANSACTION RECORD

DATE	DOCUMENT NO.	RECEIVED FROM / EXPENDED TO	QUANTITY REC'D	QUANTITY EXPENDED	QUANTITY BALANCE	I ACKNOWLEDGE CUSTODY OF THIS ITEM IN THE QUANTITY SPECIFIED.



(Card No.) | (Department) | (FSN/Part No.) | (Noun name) | (Allowance) | (U/I) | (A/L No. - Page-Line) | (Unit price)

CONTROLLED-EQUIPAGE CUSTODY RECORD (4442)
NAVSUP FORM 460 (Rev. 3-70)

CUSTODY SIGNATURE REQUIRED ☐ YES ☐ NO

TRANSACTION RECORD						I acknowledge custody of this item in the quantity indicated.	INVENTORY RECORD
DATE	DOCUMENT NO.	REC'D FROM/EXPEND. TO	REC'D	EXPEND.	BALANCE		
							DATE / QTY
							BY
							DATE / QTY
							BY
							DATE / QTY
							BY
							DATE / QTY
							BY
							DATE / QTY
							BY

O/S REQ'N (No.) (Qty) | O/S REQ'N (No.) (Qty) | O/S REQ'N (No.) (Qty) | O/S REQ'N (No.) (Qty) | O/S REQ'N (No.) (Qty)

SERIAL NO.

ADD'L DESCRIPTION

CARD NO. | DEPARTMENT | FSN/PART NO. | NOUN NAME | ALLOWANCE | U/I | A/L NO: PAGE: LINE: | UNIT PRICE

12 24 36 48 60 72 84

STOCK NO. 0108-501-0802

A-20060

Inventory of Controlled (Custody) Equipage

All items of controlled equipage, including items requiring a custody signature, items reported on the Navy Audiovisual Equipment Inventory Report, and plant property items must be inventoried at *least* annually during the period 15 February to 15 March. Inventories of controlled equipage are also required when any of the following situations occur:

- The ship, station, or unit is commissioned, inactivated, or reactivated.
- Upon relief of the AV divisions department head.
- Upon change of command at the discretion of the relieving commanding officer. Although not specifically required, an inventory should also be conducted whenever the audiovisual manager or officer or supply PO are relieved of their duties.

A Controlled-Equipage Custody Record (4442), NAVSUP Form 306 or 460, is usually used to conduct the controlled equipage inventory. Each article is sighted and inspected for serviceability by the person making the inventory. Articles identified by serial number are checked by those numbers when inventories are taken.

As the inventory progresses, the person conducting the appropriate inventory signs the custody record acknowledging custody or inventory, as appropriate, of all the items sighted. All equipage inventories must be completed within 30 days after the date of commencement. When taken jointly by the relieved and relieving head of department, for example, the inventory should be completed prior to detachment of the outgoing head.

Upon completion of the equipage inventory, the department head submits a letter to the commanding officer and a copy to the supply officer. When possible, as appropriate, the letter is a joint report from the relieved and relieving head of department and both sign the report. The report includes the following information:

- The department equipage inventory has been completed.

- Required requests for issues and survey have been submitted for shortages and unserviceable items found during the inventory or the reasons why they have not been submitted.

Any shortages or unserviceable items found during the inventory must be covered by a GPLD (Government Property Lost or Damaged) Survey Certificate (DD Form 2090); Report of Survey (DD Form 200); Missing, Lost, Stolen, or Recovered Government Property (OPNAV Report 5500-1); and/or Navy Audiovisual Equipment Inventory Report as appropriate.

MISSING, LOST, STOLEN OR RECOVERED GOVERNMENT PROPERTY

The Navy has long recognized the importance of maintaining statistics to determine where, when, and how Navy property was missing, lost, or stolen. Based on this premise, Missing, Lost, Stolen or Recovered (MLSR) Government Property Reports must be submitted to proper authorities within the Department of the Navy with the ultimate goal of improving the Navy's physical security program. In order to ensure the MLSR program's success, commands must report all MLSR incidents and accurately describe the circumstances. The major benefit will be significant improvements in ship and shore physical security programs. The reporting of these incidents by MLSR is independent of requesting investigative assistance by the Naval Investigative Service.

Details of the MLSR program are given in SECNAVINST 5500.4. All senior Photographer's Mates and audiovisual managers and officers should be familiar with this instruction.

AV EQUIPMENT INCLUDED UNDER THE MLSR PROGRAM

Because of the nature and expense of AV equipment and some supplies, most AV material is covered under the MLSR program. The following categories are specifically covered and MLSR reports *must* be made when items in these categories are missing, lost, stolen, or recovered.

- All *serialized* Navy owned, leased, rented, or borrowed AV property having a value of $100 or more.

- All *unserialized* Navy owned, leased, rented, or borrowed AV property having a value of $500 or more.

- All *unserialized* Navy owned, leased, rented, or borrowed AV property considered to be "sensitive items" regardless of the actual or estimated value. Sensitive items for this purpose are considered to be precious metals, highly technical devices, and classified material.

- A cumulative loss of serialized or unserialized property items exceeding $500 through the same incident even though a single item does not exceed the minimum given above.

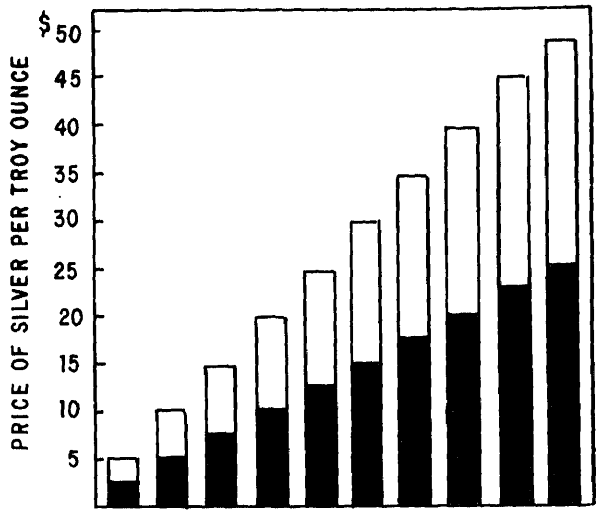
In addition to MLSR reports, surveys are also required. Specific procedures for conducting surveys are given in supply publications. For your reference the basic procedures are described in Appendix IV of this text.

APPENDIX I

SILVER RECOVERY

Like most of the world's natural resources, silver, which forms the image on most photographic films, is a valuable and diminishing resource. Unlike many other natural resources, the silver used in photography is not destroyed in its use. Much of the silver can be recovered, refined, and used again.

In photography, silver is generally recovered from two main sources: photographic solutions and scraps (film and paper). When most films and papers are processed, some of the silver they contain is removed in the fixing bath. With positive type B&W films, as much as 80 percent of the silver that was in the emulsion may be removed during fixing. With color films and paper, it may amount to almost 100 percent. However, when a B&W negative film or B&W paper with a high percentage of exposed area is processed, most of the silver remains in the emulsion. Most of the silver which remains in any film or paper can be recovered when the film or paper is treated as scrap for recovery purposes.



Approximate value of silver in one gallon of used fixer.

LET'S TALK MONEY

If someone had told you back in 1977 that in 2 short years the price of silver would increase fourfold, would you have believed it? To get some idea of the profitability of recovering silver from used photographic fixer (hypo), assume there is 1/2 troy ounce of silver in a gallon of used fixer. Since we cannot make assumptions about the price of silver, the graph shows the approximate value of silver in the fix over a wide range of prices which have occurred in recent years.

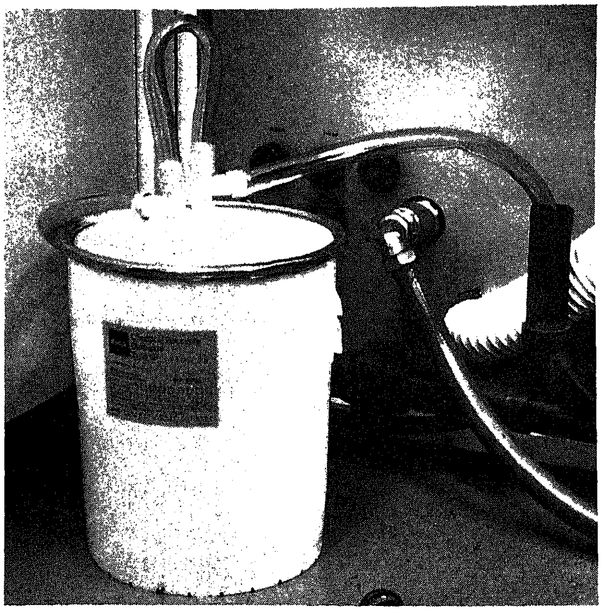
Silver recovery is obviously profitable to our Government. Not only is it profitable, but to comply with increasingly stringent sewer codes and other regulatory guidelines silver recovery is imperative. And if that is not enough incentive, remember, the recovery of silver is in the interest of our national security.

SILVER RECOVERY TECHNOLOGY

Three different methods are available for recovering silver from used photographic fixers. They are:

- Chemical precipitation
- Metallic replacement
- Electrolytic plating

Chemical precipitation is most effective but is seldom used because of its inconvenience and high labor cost. Metallic replacement uses steel wool tightly packed in a plastic cartridge. The



Courtesy Eastman Kodak Company

Silver recovery cartridge.

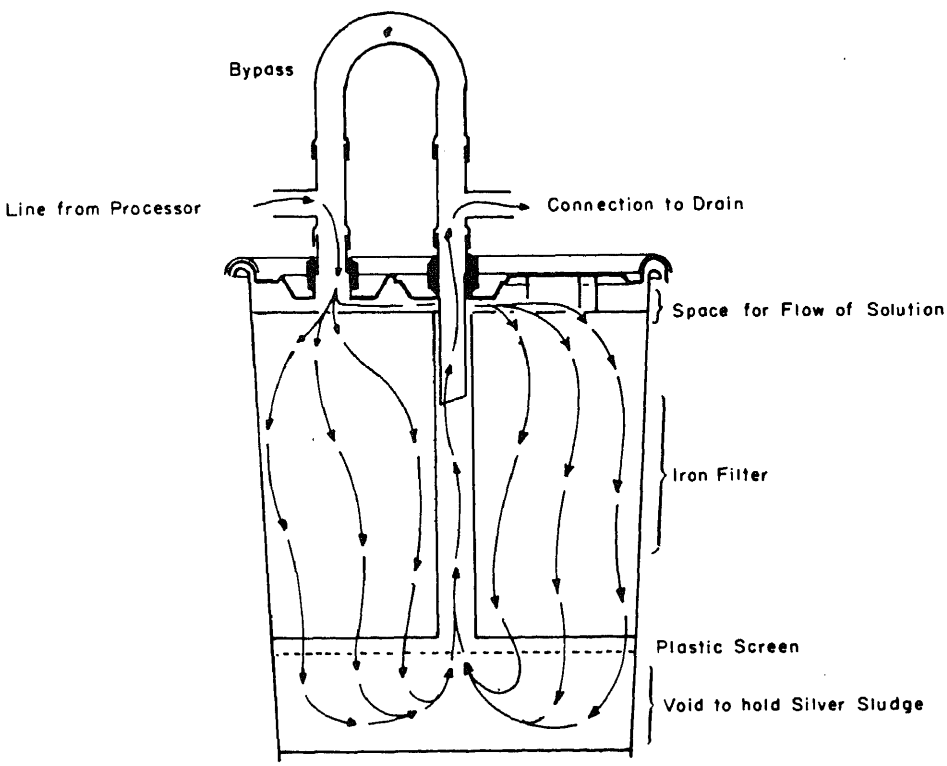
system is very cheap and well suited to the small volume user (fixer consumption less than a gallon or two per day). Most Navy photo labs have found that electroplating best meets their needs. Since the steel wool units are capable of desilvering to a lower level than plating units, some labs electroplate first and then give the fix a final treatment through steel wool.

Electroplating equipment is very simple and actually much easier to operate and control than the processing machines which generate used fixer.

METALLIC REPLACEMENT

The metallic replacement method of recovering silver from used fixer uses silver recovery cartridges. The cartridges look like 5-gallon buckets with tubes sticking out of the cover. When new, the cartridge is filled with steel wool or a wire screen-type material.

Silver recovery cartridges operate on the principle of metal ion exchange. This means that when fixer containing silver is passed through the



©Eastman Kodak Company, 1983.

cartridge, the iron in the steel wool or wire screen replaces the silver ion in the fixer. The silver then drops to the bottom of the cartridge as impure metallic silver sludge, and the iron ion, which is now in the fixer, is carried out of the cartridge with the fixer and down the drain.

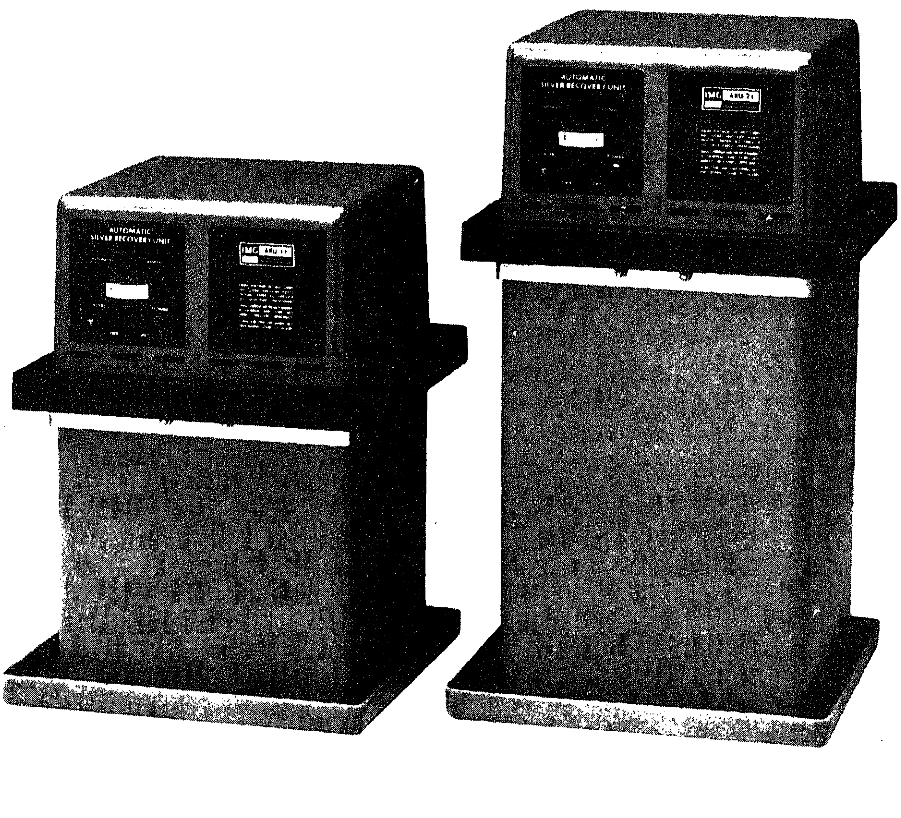
After a given period of use, the filter material in the cartridge will dissolve and the cartridge must be replaced. After about 80 percent of the steel wool or screen has been dissolved, the cartridge will allow silver to pass through, making the system inefficient. The cartridge, therefore, must be considered exhausted before the filter is completely dissolved.

ELECTROLYTIC PLATING

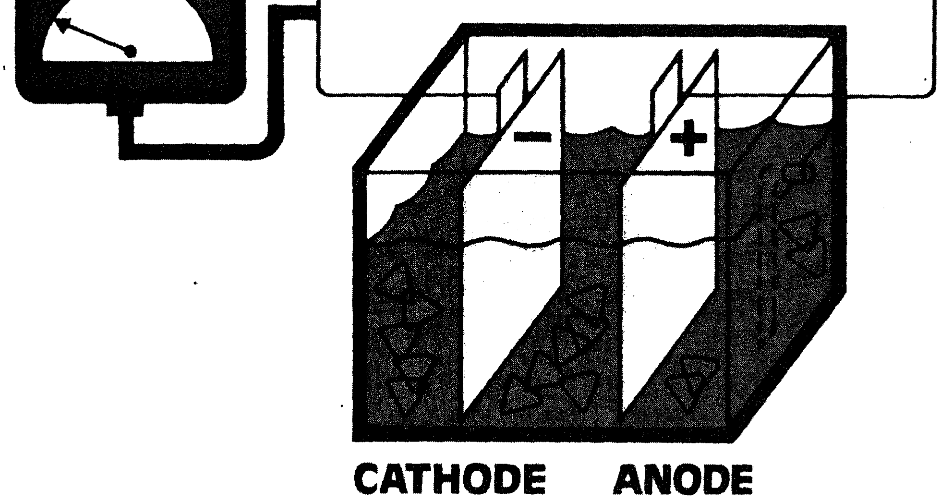
Electrolytic plating silver recovery units are more complex than silver recovery cartridges. Their initial cost is higher than that of cartridges but not so high that they should not be considered as the primary means of recovering silver from fixers and bleach fixers. Their convenience and long life pays off in the long run.

The electrolytic plating method of silver recovery uses two electrodes (a cathode and an anode) which are placed in the silver bearing solution. An electric current is passed between the electrodes, causing the silver to plate out onto the cathode. The silver recovery capacity of the unit is determined by its current density (the amount of direct current measured in amperes as related to the surface area of the cathode) and the size of the cathode.

Tank size is another measure of recovery capacity. Smaller tanks usually have less plating capacity due to a proportionately smaller cathode surface area.



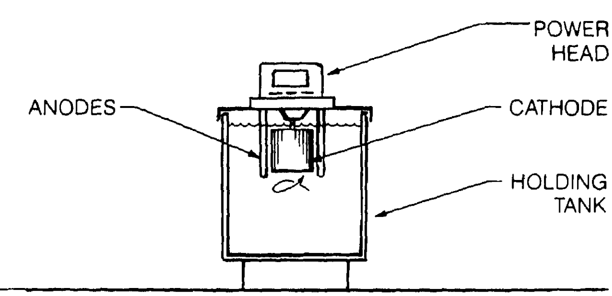
Courtesy of IMG Photo Products



The electrolytic recovery unit removes silver from used fixer through electrolytic plating. Passing a controlled electrical current between two electrodes in the solution causes the nearly pure silver to collect at the negatively charged electrode. It can be knocked off the electrode and shipped to the refiner as flake or chunks.

Agitation

An agitation or recirculation system is necessary to provide a continuous supply of silver-laden solution to the cathode. Otherwise, the current density becomes too high for the amount of silver present in the solution near the cathode and results in the formation of silver sulfide which decreases the unit's efficiency.



Cathode Design

The cathodes in various electrolytic plating units vary in design. Some units have a simple flat plate; some may have several circular disks mounted on a shaft, and some use a rotating cylinder. The cathode may be made of a flexible metal. The flexibility of the cathode makes it easy to remove the silver flake. Those cathodes that are not flexible can be lightly tapped on a flat surface to remove the silver flake, or the flake can be scraped off with a small putty knife.

SILVER RECOVERY FROM SCRAP FILM AND PAPER

The silver which remains in B&W film and paper after processing can also be recovered when the film and paper becomes scrap. If a lab has a sufficient amount of B&W scrap, the value of the silver in it can be substantial.

Courtesy of the DuPont Company

Stripping silver from the cathode.

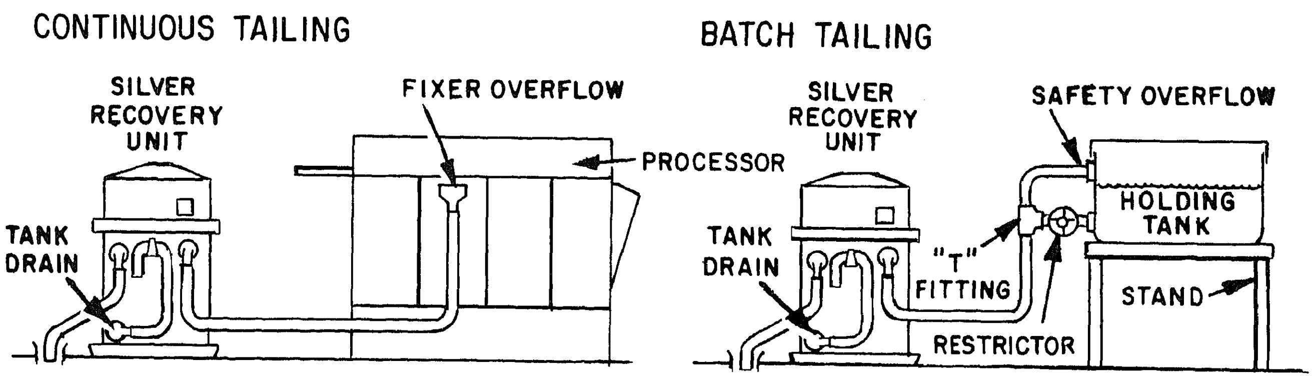
Silver recovery from scrap film and paper is more difficult than from solutions. It requires an expenditure in equipment that is beyond the scope of Navy photo labs. Two things about this scrap make silver recovery difficult. First, the base must be removed; second, the silver is not in solution. Two basic methods are used to recover silver from scrap film and paper. One method is to burn the scrap, which leaves a silver-rich ash. The other method is to remove the silver by a wet chemical treatment. Both methods require further steps to separate the silver from the ash and the chemical solution.

The need to recover as much silver as possible has caused the Department of Defense to set up a precious metals recovery program.

PRECIOUS METALS RECOVERY PROGRAM

Within the Department of Defense (DOD) there is a continuing need for silver in the manufacture of defense materials. Because of the increasingly short supply of silver from domestic sources and the need to reduce procurement cost of materials with silver in it, it has become necessary for DOD to establish a Precious Metals Recovery Program (PMRP). As photographers we are concerned with the recovery of silver. The requirements of the PMRP are set forth in DOD Directive 4160.22 "Recovery and Utilization of Precious Metals." Participation in the PMRP by all Navy photo labs is mandatory.

Navy photo labs will normally turn in all silver or silver bearing materials to their local Defense Property Disposal Office (DPDO). This may include scrap film and paper, used hypo (fixer), spent silver recovery cartridges, silver sludge and silver flake from electrolytic recovery units.



Electrolytic plating silver recovery units in use.

The recovery of silver in a refined state is done by the New York Assay Office, a facility of the Treasury Department, and by commercial refineries.

OBTAINING SILVER RECOVERY SUPPLIES AND EQUIPMENT

Requests for PMRP supplies (e.g., silver test paper, plastic collection containers for hypo, silver recovery cartridges, fittings, control valves, and replacement parts which are peculiar to silver recovery equipment) should be put in writing and sent to:

> Defense Property Disposal Precious Metals Recovery Office—Earle.
> Bldg. C-38, Naval Weapons Station, Earle, Colts Neck, NJ 07722

To acquire electrolytic silver recovery equipment you should apprise your local DPDO of the need for PMRP assistance/recovery equipment to start up silver recovery operations or to enhance the effectiveness of ongoing recovery operations to ensure maximum recovery. Arrangements will then be made to have your lab surveyed to determine the specific requirements for on-site recovery equipment.

When silver recovery equipment is required, it may be issued from stock or purchased with PMRP funds and shipped to your lab. There is no cost to the lab for this equipment.

SECURITY

How your lab handles silver bearing hypo, spent recovery cartridges, and silver sludge or flake is subject to security requirements outlined by local authority. As a minimum, however, the following security measures are suggested.

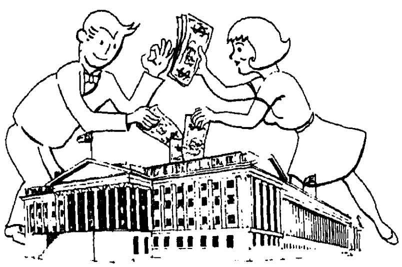
- High purity material should be stored in a safe or locked cabinet within a locked room. Bulky silver-bearing material, such as hypo and scrap film and paper should be stored in a locked room.

- Weighing and measuring of silver sludge or flake and hypo and inventory of spent recovery cartridges and scrap should be accomplished by a designated weigher in the presence of a disinterested person (the same disinterested individual should not be allowed to sign for more than two consecutive accountings), and the initials of both persons should appear on the weight or inventory document.

- Entry to areas where high purity silver is stored prior to being turned over to the local DPDO should be by access list only. This list should be kept current, limited to people with a need to enter, and posted inside the entrance. Visitors should be required to sign a visitor's register and be accompanied by an individual on the access list. The visitor should have a need to enter, and further identification can be required. Access list personnel do not require a security clearance.

- Persons entering areas where silver or silver bearing material is stored should be made aware of "condition of entry" by signs located inside the entrance to the storage area.

You Can SAVE PRECIOUS SILVER



UNITED STATES TREASURY

WHY SHOULD WE RECOVER SILVER ?

REDUCE COST OF PRODUCTION

SAVE PRECIOUS METAL RESOURCES

ORE WILL ONE DAY BE USED UP

SAVE COST OF MINING

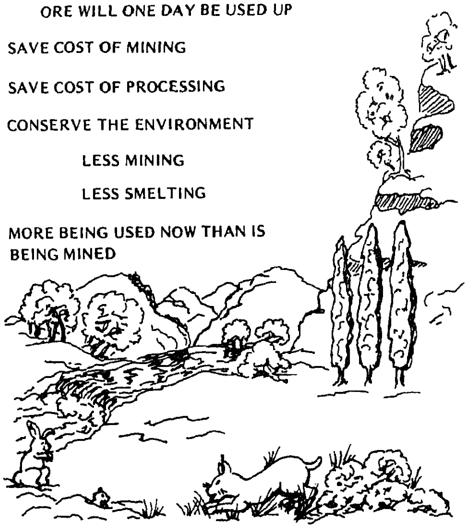
SAVE COST OF PROCESSING

CONSERVE THE ENVIRONMENT

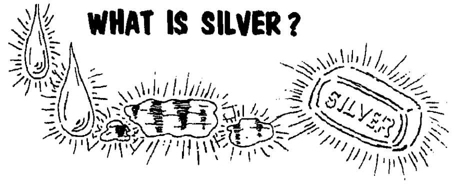
LESS MINING

LESS SMELTING

MORE BEING USED NOW THAN IS BEING MINED



WHAT IS SILVER ?



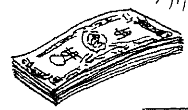
IT IS WHITEISH IN COLOR

IT IS USABLE

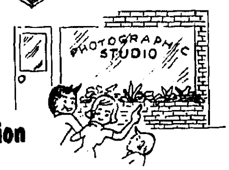
IT IS VALUABLE

IT IS A METAL

IT IS PRECIOUS



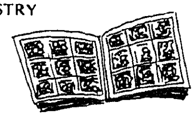
SILVER IS in Film & Photographic Solution

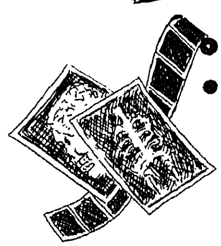


SILVER FACTS

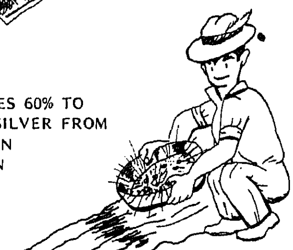
- TODAY MORE SILVER IS BEING USED THAN IS BEING MINED

- MORE SILVER IS USED IN PHOTOGRAPHIC FILMS & PAPER THAN IN ANY OTHER INDUSTRY



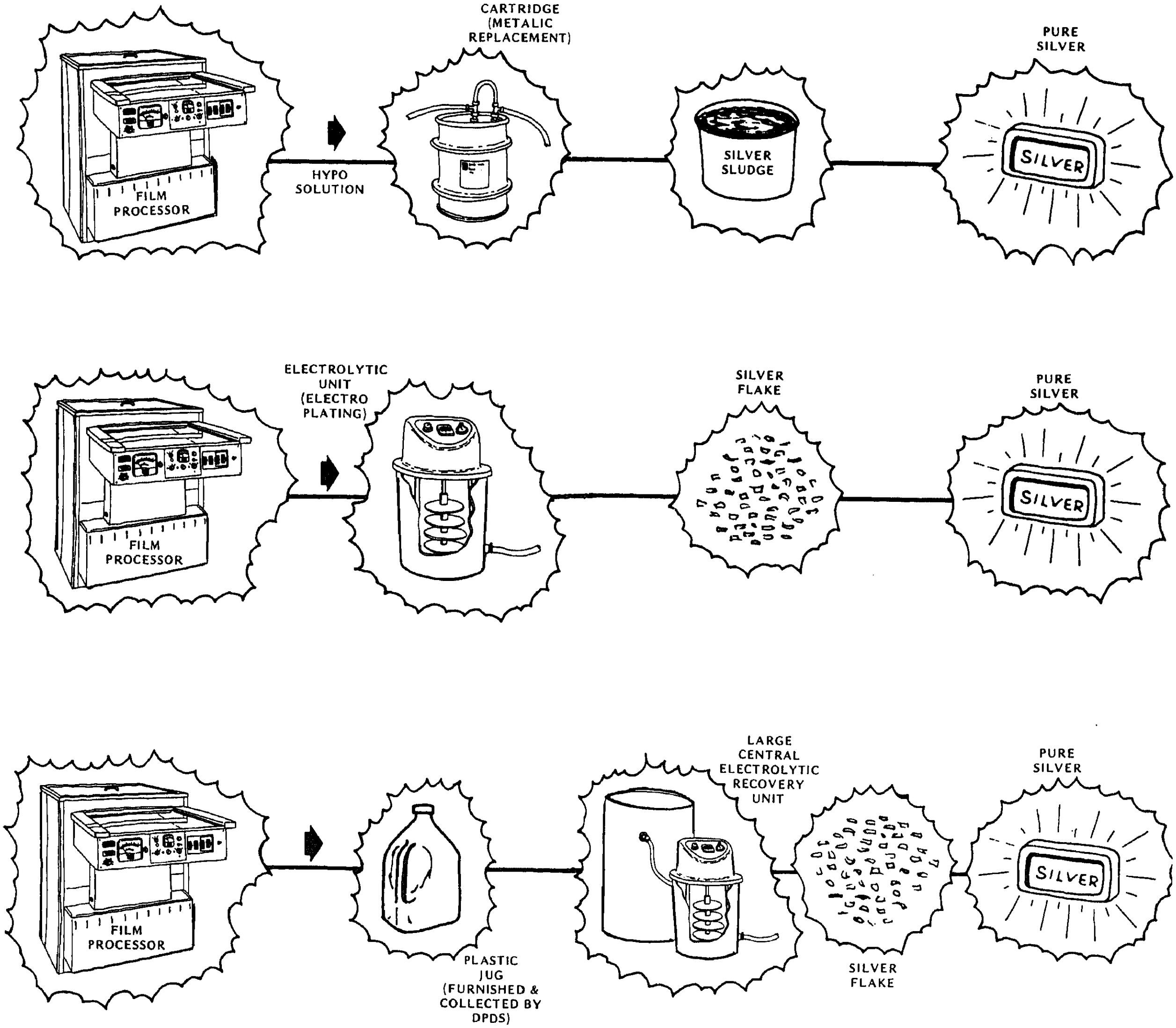


- CERTAIN SILVER COMPOUNDS HAVE ABILITY TO CHANGE WHEN EXPOSED TO LIGHT THIS MAKES MODERN PHOTOGRAPHY POSSIBLE

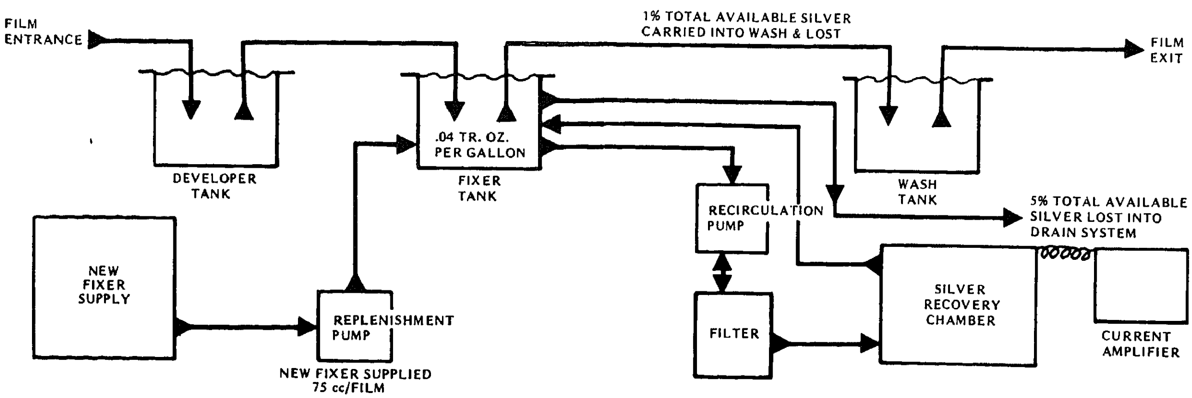


- IN SOME CASES 60% TO 80% OF THE SILVER FROM FILM IS LEFT IN THE SOLUTION

HOW SILVER IS RECLAIMED

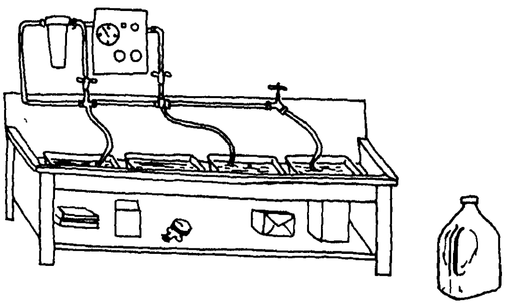


Recirculating Silver Recovery System



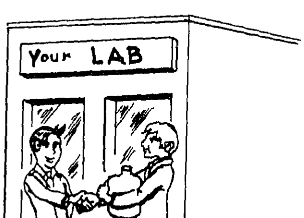
Photographic Hypo Solution
Largest Possible Source
of Reclaiming Silver

**YOU CAN USE
A PLASTIC JUG
SUPPLIED BY DPDS**

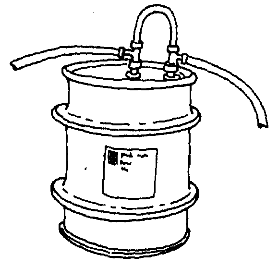


DPDS WILL ASSIST YOU

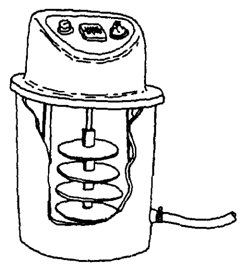
- By providing recovery equipment at no charge
- By providing technical assistance
- By collecting the hypo jug or the silver residue
- By providing "Silver Test Paper"



**OR DPDS
WILL SUPPLY
A CARTRIDGE SYSTEM**



**OR
ELECTROLYTIC UNIT**

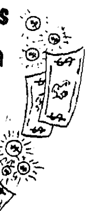


**IN ONE YEAR DPDS
RETURNED 3,608,000**
troy oz. of silver to Uncle Sam

there is
more available

REMEMBER

silver recovery means
dollars to Uncle Sam
and
tax savings
TO YOU



FOR ANY ASSISTANCE OR INFORMATION ABOUT HYPO SILVER

Contact:

DEFENSE PROPERTY DISPOSAL PRECIOUS METALS
RECOVERY OFFICE-Earle

Bldg, C-38, Naval Weapons Stations Earle
Colts Neck, NJ 07722
AV 449-1286/1443
Commercial: AC201-462-9500, Ext. 286/443

DEFENSE LOGISTICS AGENCY
DEFENSE PROPERTY DISPOSAL SERVICE

Federal Center
Battle Creek, Michigan 49016
AV369-6917
Commercial: AC616-962-6511, Ext. 6917

Or Your Local Defense Property Disposal Office

APPENDIX II

CARE OF STAINLESS STEEL

Stainless steel, which is easy to maintain, is being extensively used in photographic laboratories. If properly cared for, it presents a very impressive appearance. On the other hand, photographic equipment made of stainless steel, if carelessly used, can become badly damaged and corroded. With careful cleaning and maintenance, stainless steel will give long years of satisfactory service.

The corrosion-resistant qualities of stainless steel are achieved by the alloy used in the stainless steel, and by a special treatment called "passivation." Passivation develops a thin surface film of oxide that protects the stainless steel from corrosion and also removes corrodible materials such as iron particles and other contaminants that may exist on the surface of the alloy.

The corrosion-resistant film can be impaired, however, if the stainless steel equipment is kept in contact for any length of time with iron or its compounds or with bleaches like those used in color processing.

CLEANING

Stainless steel surfaces should be cleaned daily to prevent the buildup of dirt and chemical deposits which, if permitted to remain for a lengthy period, will harm the finish. Stainless steel requires exposure to air in order to remain bright and shiny.

Stainless steel has a polishing line or a "grain" like wood; clean in the direction of this "grain"—not against it.

Never, use steel wool, grit cleaners, or grit papers to clean stainless steel. Their use will abrade the surface and cause corrosion. Always follow recommended methods for maintenance and care of stainless steel equipment.

- *Daily*—Wipe down all stainless steel equipment with a wet cloth.

- *Weekly*—Thoroughly scrub and wash with a nongrit soap or cleaner of the mildest type possible. Do not permit the cleaning solution to remain on the stainless steel for long periods as it may cause discoloration.

- Stainless steel surfaces should be wiped dry with a soft, dry cloth after cleaning and rinsing.

- A silicone-base polish is recommended for polishing stainless steel. The National Stock Number for silicone-base polish is: *Polish, metal, spray can,* 9Q 7930-00-926-5171.

Whenever detrimental compounds contact the surface of the stainless steel, take immediate action to wash them away thoroughly.

APPENDIX III

DD FORMS 1348

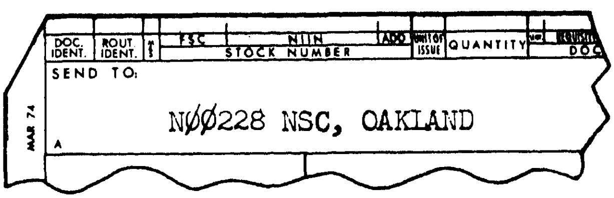
The material presented in this appendix is provided as a ready source of information for you to use in doing your work as the "storekeeper" in the AV facility. You will NOT be tested on this information in either the NRCC for this text or in advancement in rate exams.

PREPARATION OF DD FORMS 1348

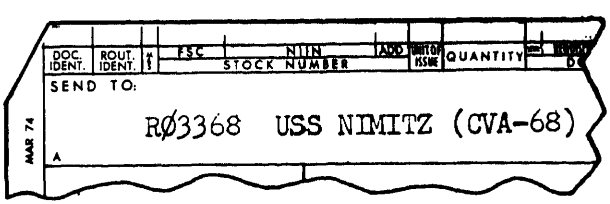
Most of the information shown on the DD Form 1348 is represented by codes. These codes apply to all levels of supply and are too extensive for all of them to be included in this manual. However, some of the more common ones are included in the data block entry descriptions below. All codes are published in appendices of NAVSUP P-485.

In the descriptions below, the data block letter or number is shown first, then the field legend, or title, as printed on the form, and finally, a description or explanation of the data shown in that block.

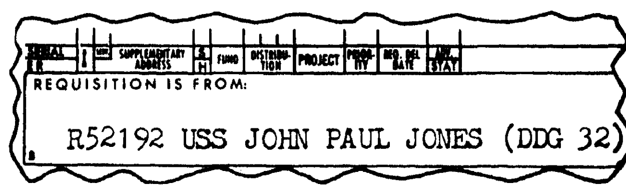
DATA BLOCK A, SEND TO—Identification of the supply source is a mandatory entry. If the requisition is to be submitted to a shore activity, enter the service designator code, unit identification code (UIC), name and location of the activity to which the requisition will be submitted. If the requisition is to be submitted to another ship, enter the service designator code, UIC, name and hull number of the ship.



OR



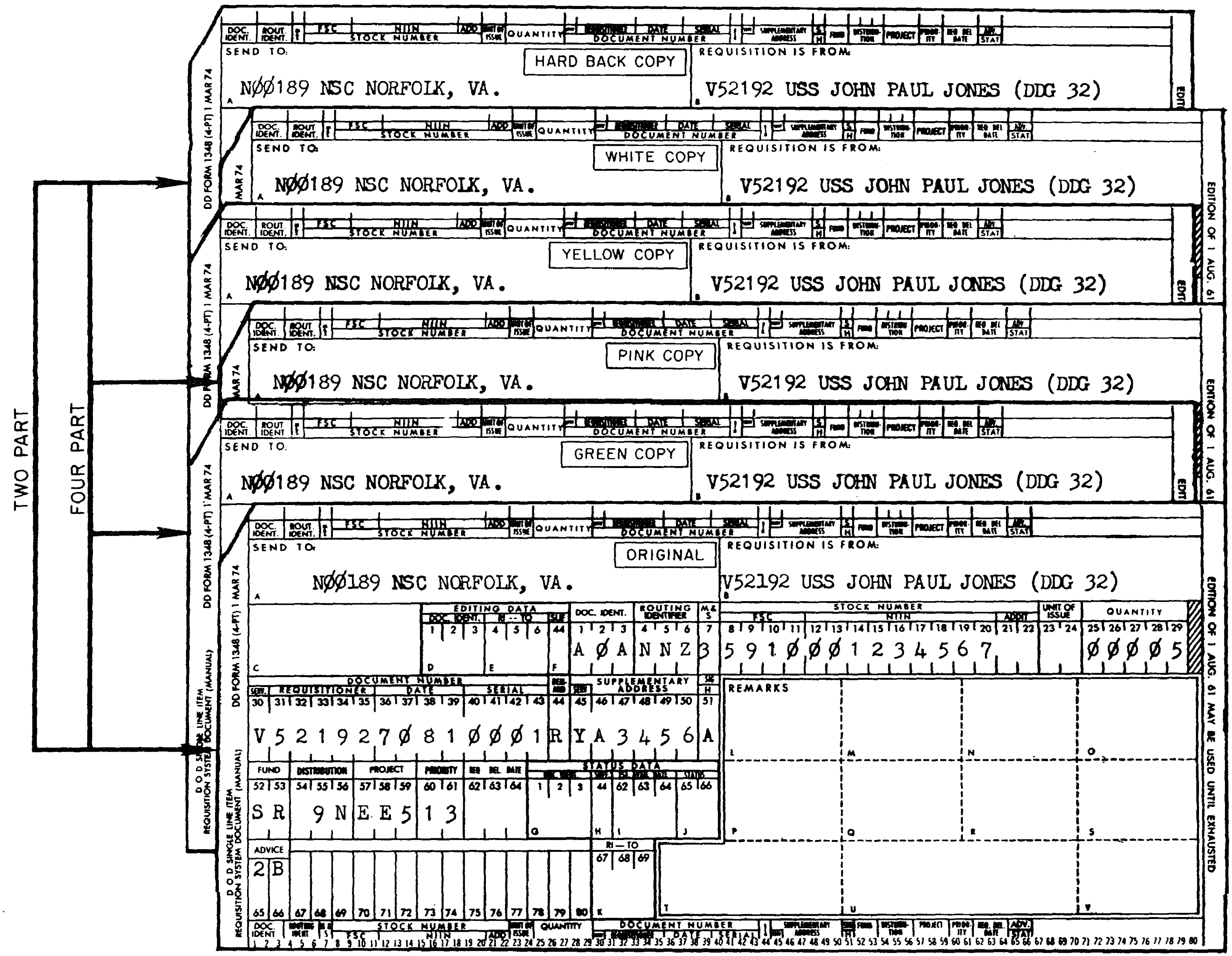
DATA BLOCK B, REQUISITION IS FROM—Identification of requisitioner is a mandatory entry. Enter the service designator code, unit identification code, and/or name and hull number of the requesting ship.



DATA BLOCK C—At the discretion of the supply officer, enter the name of the requested item in block C or leave blank.

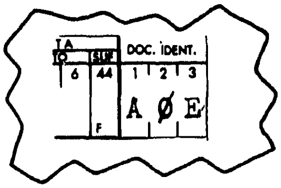
DATA BLOCKS D, E, AND F, EDITING DATA—These blocks are left blank.

CARD COLUMN (CC) 1-3, DOCUMENT IDENTIFIER—The document identifier identifies the purpose of the document (requisition, followup, cancellation, etc.). The appropriate



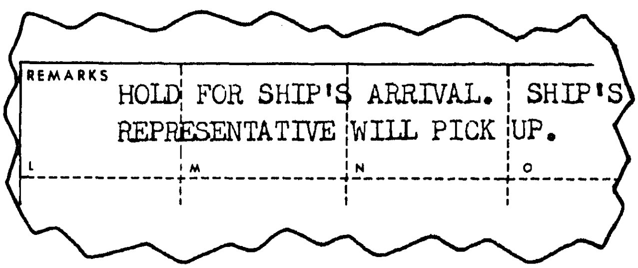
DOD Single Line Item Requisition System Document (Manual) (2, 4, and 6 part form), DD Form 1348

three-position document identifier code is entered as follows:

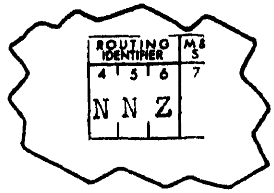


Requisition for overseas shipment		Requisition for domestic shipment
AØ1	With NSN/NATO number	AØA
AØ5	With exception data	AØE

When a requisition contains any information in the "remarks" block (authority for the requisition, special accounting information, special delivery instructions, additional identification information, etc.), the requisition is said to contain "exception data" and document identifier AØ5 or AØE is used.

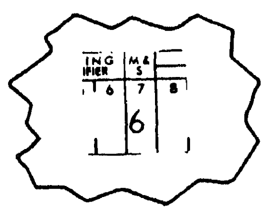


CARD COLUMN 4-6, ROUTING IDENTIFIER—Routing identifiers are three-character codes that identify a specific activity. They are assigned to all DOD and GSA supply support activities, and other activities ahsore with supply departments. The routing identifier must agree with the activity shown in data block A. This block is left blank on requisitions submitted to nonautomated ships for which no routing identifier is asigned. Many of the naval supply activities have more than one routing identifier. On all requisitions to a supply activity, use the routing identifier for Navy material; e.g., NNZ. The others are for use in interservice transactions.



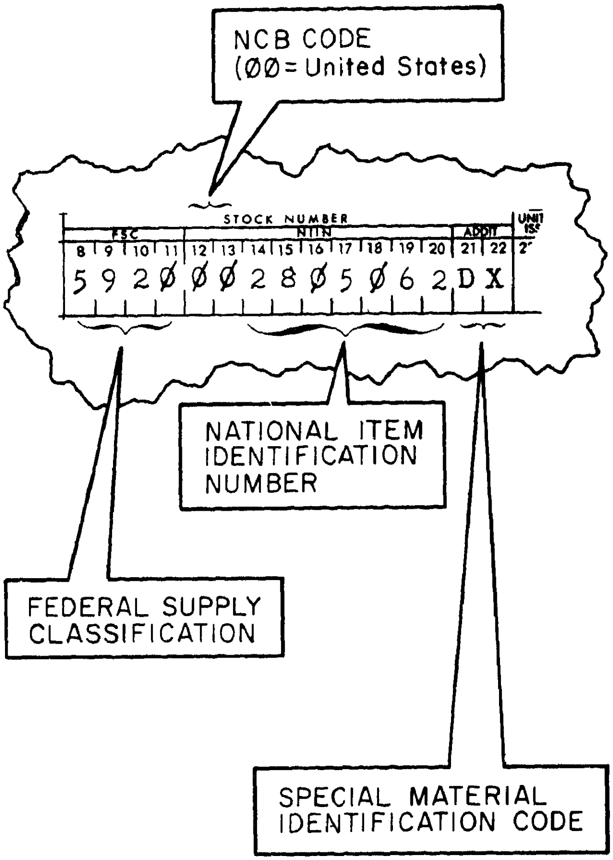
CARD COLUMN 7, M & S CODE—The media and status code is a single-character code that indicates the type of status required, who is to receive the status, and how the status is to be furnished. Appropriate codes may be selected to provide:

- No status
- Exception status
- Exception status plus shipping status
- 100% supply status
- 100% supply status plus shipping status



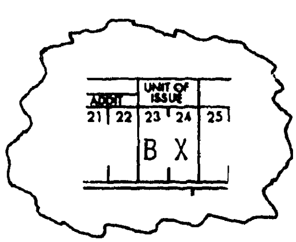
CARD COLUMNS 8-22, STOCK NUMBER—When requisitioning material with an NSN, the four-character Federal Supply Classification (FSC) is entered in CC 8-11; the two-character National Codification Bureau (NCB) code and the remaining seven characters of the National Item Identification Number (NIIN) are entered in CC 12-20. When applicable to a designated item, the two-character Special

Material Identification Code (SMIC) must be entered in Card Columns 21-22.

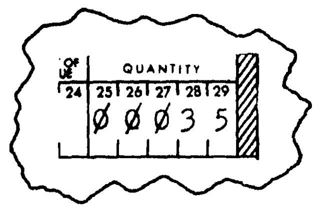


When requisitioning items that can be identified only by a part number, or by a local item control number, the DD Form 1348-6 (discussed later in this chapter) is to be used.

CARD COLUMNS 23-24, UNIT OF ISSUE—Enter the two-letter unit of issue abbreviation for the item being requisitioned. For example, if the unit of issue for the item requisitioned is box, the entry in Card Columns 23-24 will be BX.



CARD COLUMNS 25-29, QUANTITY—Enter the quantity of the item required. If the quantity exceeds 99,999, additional requisitions must be prepared and submitted for the remainder of the order. When the item requisitioned is required in a minimum length, size, or other requirement that cannot be covered by an advice code, enter the specific requirement (e.g., minimum length acceptable 10 ft) in the "remarks" block and identify the requisition as containing exception data by entering AØ5 or AØE in Card Columns 1-3. Also, when the total requirement of an item involves two or more urgencies of need (e.g., immediate use and routine stock replenishment), separate requisitions are required for the partial quantities of the total requirement. When the requested quantity does not require five significant digits, enter zeros in the blank spaces preceding the significant digits.



Requisitions which will result in multiple receipts of material or services, such as continuing and annual requirements for gasoline, telephone service, or laundry, etc., must indicate "C9999" in Card Columns 25-29.

CARD COLUMN 30, SERVICE—A one-letter code to identify the service or component of the service. Navy codes are:

R—Fleet operating units of CINCPACFLT

V—Fleet operating units of CINCLANTFLT

N—All activities other than fleet operating units of CINCPACFLT/CINCLANTFLT

CARD COLUMNS 31-35, REQUISITIONER—The unit identification code (UIC) of the ship or activity. If the number is less than five digits, it is preceded by zeros.

CARD COLUMNS 36-39, DATE—Enter the four digits representing the Julian date on which the requisition is actually transmitted to the supply source. The first position represents the last digit of the calendar year. The last three positions indicate the numeric consecutive day of the calendar year. For example, 4299 represents 25 October 1984. The numeric consecutive day of the calendar year can be found on Government issue calendar pads.

CARD COLUMNS 40-43, SERIAL—Enter a four-position serial number. The first position of the serial number may be a numeric (Ø through 9), or an alphabetic (A through G, or W); however, G or W is used only in Not Operationally Ready (NORS) requisitions. The remaining three positions of the serial number are numeric (ØØ1 through 999). Under no circumstances may duplicate serial numbers be assigned on the same day.

Blocks of serial numbers may be assigned to various departments and/or to specific commodities of material, except that serial numbers 97ØØ through 9999 are used only in requisitions for ship's store items, including retail clothing.

CARD COLUMN 44, DEMAND—The demand code is a mandatory entry of a single alphabetic character and is assigned as follows:

R—RECURRING DEMAND—All requisitions except those for which demand code N or O is applicable.

N—NONRECURRING DEMAND—All requisitions for:

Initial allowances.

Materials for space or equipment alterations; e.g., modernization, retrofit, special projection alterations (SPALTs), and other material requests clearly identified as one-time requirements.

O—NO DEMAND—Requisitions for substitute items which can be supplied more readily than preferred items which have been requisitioned previously and which still are desired when available.

In selecting demand codes it should be remembered that inventory managers rely upon demand codes (specifically demand code R) to determine the items for which procurement funds will be invested to ensure their continual availability. Do not use the recurring demand code R indiscriminately. Demand code N should be used when the requirement clearly meets any of the criteria listed for nonrecurring demands.

Two separate requisitions (one coded R and one coded N) may be necessary to satisfy a single requirement. For example, if the on-hand stock of an item is 3, and the current requisitioning objective is 6, and an increased requisitioning objective of 12 is a result of increased demand history, one requisition for the original deficiency of 3 is coded as recurring demand (R) and the other requisition for the increase of 6 in the new requisitioning objective is coded as nonrecurring (N).

CARD COLUMNS 45-50, SUPPLEMENTARY ADDRESS—When using the supplementary address field as a "Ship to" or "Bill to" address, the appropriate service code and UIC are entered in CC 45-50. When material is to be shipped and billed to the requisitioner, CC 45-50 may be used for local information such as a stowage location, a work center code, a controlled equipage custody record number, etc. When local information is entered in CC 46-50, CC 45 always contains a "Y."

In requisitions for Not Carried (NC) material other than controlled equipage and Selected Item Management Direct Turnover (SIM DTO) items, enter "N" in CC 46, and the requester's work center code in CC 47-50. In requisitions for Not In Stock (NIS) material and SIM DTO items, enter "S" in CC 46 (to signify that a stock record is maintained), and the requester's work center code in CC 47-50.

In requisitions for controlled equipage items, enter "E" in CC 46 and the appropriate equipage custody card number in CC 47-50.

In requisitions for equipage items other than controlled equipage, enter "E" in CC 46, and the requester's work center code in CC 47-50.

CARD COLUMN 51, SIGNAL—A single alphabetic code that designates the activity to receive the material (ship to) and the activity to be charged for the issue (bill to).

When material is to be shipped to the requisitioner (Card Columns 31-35):

A—Requisitioner will be billed.

B—Supplementary addressee will be billed (Card Columns 46-50).

D—No billing required (free issue). Used only when requisitioning material identified by cognizance symbols ØI and ØP (publications).

When material is to be shipped to the supplementary address (Card Columns 46-50):

J—Requisitioner will be billed.

K—Supplementary addressee will be billed.

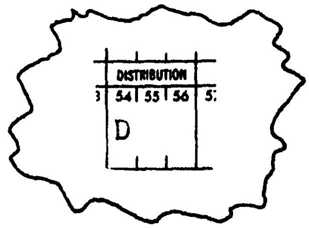
M—No billing required (free issue). Used for items indicated for signal code D.

Requisitioner may use "Y" and a local code only with signal codes A and D.

"D" or "M" is not used when requisitioning Appropriation Purchases Account (APA) material since such material is charged for statistical purposes even though operating funds are not affected. If there are accounting instructions that cannot be covered by use of the signal and fund codes, such instructions are written in the "remarks" field (data blocks L through V). In this instance, document identifier AØ5 or AØE is used.

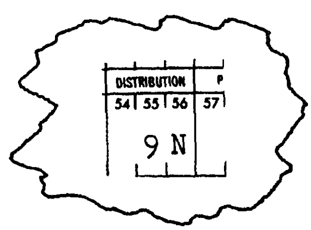
CARD COLUMNS 52-53, FUND CODE—The applicable two-character fund code (see NAVSO P-3013, Appendix II) is entered in all requisitions except for free issues which are identified by a signal code D or M entered in Card Column 51. The fund code field is left blank on a free issue requisition.

CARD COLUMNS 54-56, DISTRIBUTION—The distribution field of a requisition is a dual-purpose field with two different uses for the Navy Supply System. The first position (when used) indicates a monitoring activity and the other two positions indicate the cognizance symbol.



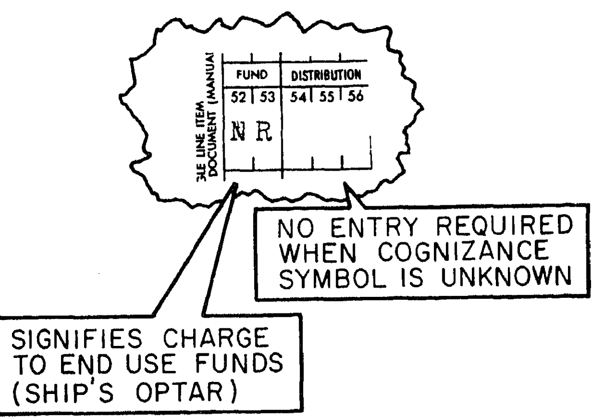
Monitoring Activity—When an entry is made in Card Column 54 of the distribution field, it will represent a specific monitoring activity (see Appendix 3 of NAVSUP P-485) that is to receive 100% supply and shipment status. Such status is in addition to that provided the requisitioner or supplementary addressee by the M & S code assigned in Card Column 7. For example; if USS *John Paul Jones* (DDG-32), while deployed in the Pacific, initiates an issue group ONE requisition, the character D would be entered in Card Column 54 to designate Special Programs Section, NSC Oakland, as the monitoring activity.

Cognizance Symbol—The cognizance symbol entry is the two-character numeric and alpha code prefixed to National Stock Numbers as listed in the ML-N, allowance list, or other source. The first character of the cognizance symbol indicates the stores account and is entered in Card Column 55 of the distribution field. Odd numbers specify Navy Stock Account (NSA) material, and even numbers specify either Appropriation Purchases Account (APA) material or nonstores account material. The second character of the symbol indicates the cognizant inventory manager and is entered in Card Column 56. For example, if the cognizance symbol is 9N, it appears in the distribution field.

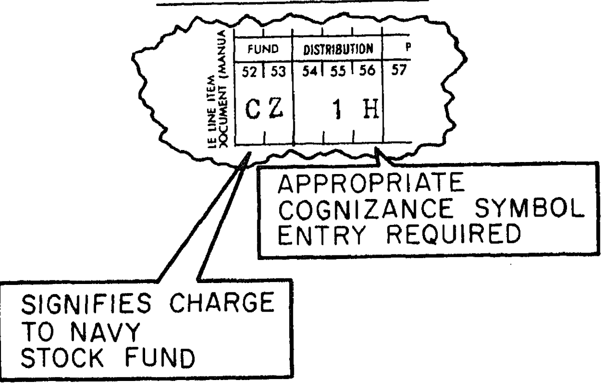


When the cognizance symbol is not known and the fund code cited does not signify a charge to an allotment under the Navy Stock Fund (NSF), leave Card Columns 55-56 blank. If the fund code cited signifies a charge to an allotment under the Navy Stock Fund, a cognizance symbol compatible with the fund code is entered. For example, a USS *John Paul Jones* (DDG-32) requisition citing fund code NR, for a machinery repair part which cannot be identified to a National Stock Number, does not require a cognizance symbol to be entered in the distribution field. However, a USS *Puget Sound* (AD-38) requisition citing fund code CZ for the same item would have the cognizance symbol entry 1H in Card Columns 55-56. Entries would appear as follows:

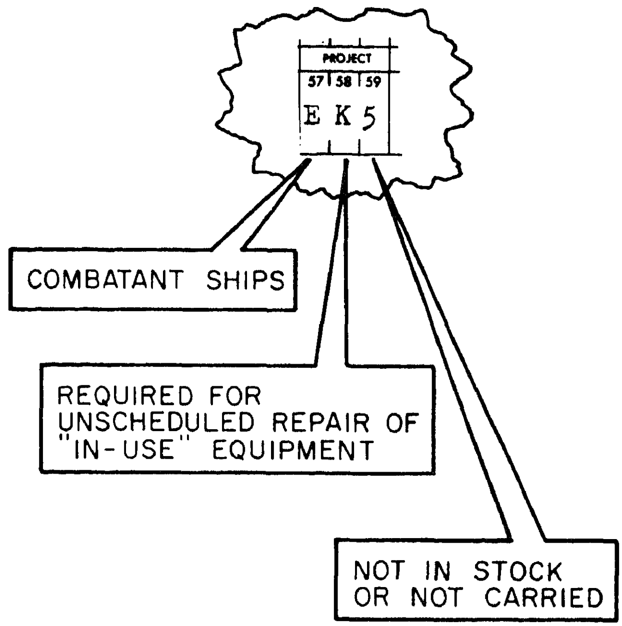
USS JOHN PAUL JONES



USS PUGET SOUND



CARD COLUMNS 57-59, PROJECT—The project code is a mandatory three-character entry used to identify the purpose or nature of the requirement. These codes are recognized throughout any distribution system and assist the supplier in determining the appropriate method of handling and marking of shipments. The third position of the project code may be used to provide the sixth digit of a storage location if needed. (See Appendix 6 of NAVSUP P-485 for a complete listing of codes.)

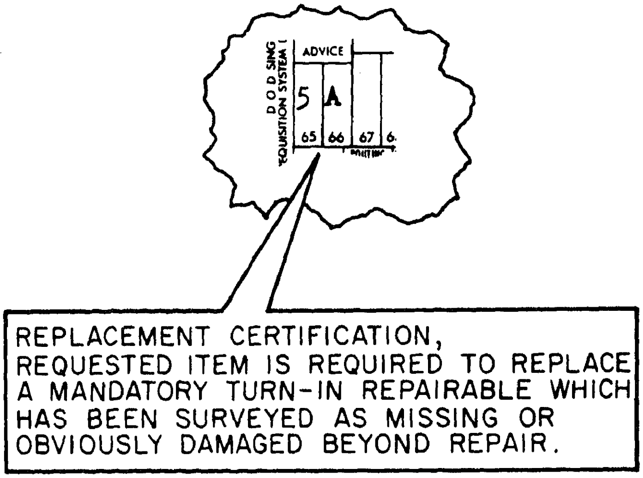


CARD COLUMNS 60-61, PRIORITY—A numeric code assigned by the requisitioner which indicates the mission of the requisitioner and the urgency of need for the material. The Issue Priority Designator (IPD) is assigned in accordance with the procedures explained in chapter 8 of this manual.

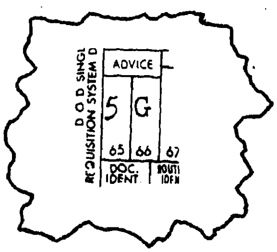
CARD COLUMNS 62-64, REQUIRED DELIVERY DATE—The standard delivery date for the assigned issue priority designator normally is considered to be the required delivery date; therefore, no required delivery date is entered in Card Columns 62-64 except under certain conditions covered in NAVSUP P-485.

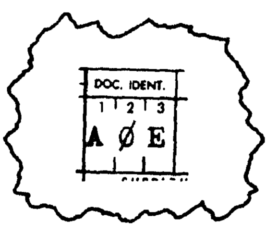
DATA BLOCKS G, H, I, J, AND K, STATUS DATA—These blocks are left blank.

CARD COLUMNS 65-66, ADVICE—The advice code is used to provide specific instructions or required information to the supplier. This is not a mandatory entry and should be used only when necessary to the supply action as required for certain types of material. The following is an example and explanation on the use of advice code 5A.



All requisitions for mandatory turn-in repairables must contain the proper advice code (5A, 5D, 5G, 5S, or 5X) in Card Columns 65-66. These advice codes have special significance for mandatory turn-in repairables, and as such take precedence over any other advice code. Any other advice code, in this case, must be entered in the "remarks" block of the requisition and a document identifier of AØ5 or AØE, as appropriate, is entered in Card Columns 1-3.





DATA BLOCKS L-V, REMARKS—These blocks are used to convey necessary exception data pertinent to the processing of the requisition by the supply activity. When exception data is entered in the "remarks" block, document identifier code AØE or AØ5 as appropriate must be entered in Card Columns 1-3. Exception data should be used only when required because the use of document identifier AØ5 or AØE precludes automatic processing of the requisition by computerized supply activities. Exception data normally must be limited to:

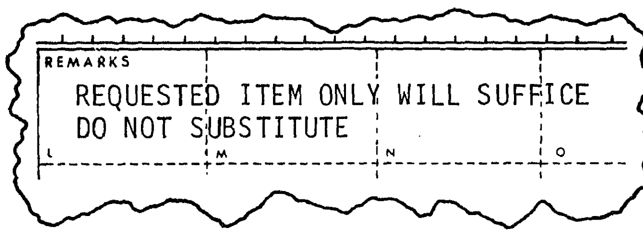
- Special funding instructions.

- An additional advice code, if required, when advice code 5A, 5D, 5G, 5S, or 5X is entered in Card Columns 65-66.

- Authorization for the item when requirement is imposed by higher authority (e.g., type commander, systems command, etc.).

- Essential "mark for" address.

- "Ship to" or "bill to" address when it cannot be designated by a coded entry in Card Columns 30-43 (requisitioner) or Card Columns 45-50 (supplementary address).



NON-NSN REQUISITION DOCUMENT DD FORM 1348-6

The DD Form 1348-6 is used to requisition material which cannot be identified by an NSN, a NATO stock number, or a Navy Item Control Number (NICN) (other than a permanent "LL" coded NICN). The form illustrated in the next figure consists of two sections. The upper section includes essentially the same data elements as those in a DD Form 1348; the lower section includes nine data blocks for additional identification data.

S/N 0102-LF-013-2271

DOCUMENT IDENTIFIER			ROUTING IDENTIFIER			M & S	MANUFACTURER'S CODE ★ AND PART NUMBER: FSCM (8–12), PART NUMBER (13–22)	UNIT OF ISSUE		QUANTITY					DOCUMENT NUMBER: SERV / REQUISITIONER / DATE / SERIAL
1	2	3	4	5	6	7	8–22	23	24	25	26	27	28	29	30–43
A	Ø	E	N	D	Z	W		E	A	Ø	Ø	Ø	Ø	1	R 5 2 1 9 2 7 2 1 2 Ø 3 1 4

DEMAND	SUPPLEMENTARY ADDRESS (SERV)	SIGNAL	FUND CODE	DISTRIBUTION CODE	PROJECT CODE	PRIORITY	REQUIRED DELIVERY DATE	ADVICE CODE	BLANK		REJECT CODE (FOR USE BY SUPPLY SOURCE ONLY) 65	66
44	45–50	51	52–53	54–56	57–59	60–61	62–64	65–66	67–69	70–80		
N	Y N E B 1 3	A	N R			Ø 5				1 5 Ø Ø Ø (76–80)		

IDENTIFICATION DATA

★ 1. MANUFACTURER'S CODE & PART NO. *(When they exceed Card Columns 8 thru 22)*
Ø5Ø73-N3-12291-P1Ø4

2. MANUFACTURER'S NAME
BABCOCK & WILCOX CO. NEW YORK, N. Y.

3. MANUFACTURER'S CATALOG IDENTIFICATION AND DATE

4. TECHNICAL ORDER NUMBER

FOLD LINE

5. TECHNICAL MANUAL NUMBER
NAVY TECH MANUAL 351-ØØ48

6. NAME OF ITEM REQUESTED
ELEMENT, SOOT BLOWER, UNIT A

7. DESCRIPTION OF ITEM REQUESTED

7 *a*. COLOR

7 *b*. SIZE

8. END ITEM APPLICATION AND SOURCE OF SUPPLY
BOILER, STM, MN 634 PSI 4617 CU FT 1393 TB BABCOCK & WILCOX CO. NEW YORK, N. Y.

8 *a*. MAKE | 8 *b*. MODEL NUMBER | 8 *c*. SERIES | 8 *d*. SERIAL NUMBER

9. REMARKS
(ADDITIONAL EQUIP DATA)
APL # Ø212ØØØØ7
MFR DWG # MX 253ØØ1
EQUIP PATTERN # 12
EQUIP SPEC MIL-B-18381 SHIPS
IAPL-22-ØØ1

(ADDITIONAL ITEM DATA)
NICN 441Ø-LL-CAO-ØØØ1

DD FORM 1 MAR 74 1348-6 EDITION OF 1 JAN 71 MAY BE USED UNTIL EXHAUSTED **NON-NSN REQUISITION** *(MANUAL)*

NOTE: DD FORM 1348-6 IS A 6-PART SNAPOUT FORM WITH MULTICOLORED INTERLEAVED COPIES. IT IS PERFORATED AT FOLD LINE TO PERMIT FOLDING TO SIZE OF A REQUISITION.

Non-NSN Requisition, DD Form 1348-6.

The following information provides Card Column and data block entry explanations for the DD Form 1348-6.

Card Column	Field Legend	Explanation
1-3	Document identifier	Enter document identifier AØ5 or AØE as appropriate.
4-6	Routing identifier	Enter routing identifier of stock point to whom the requisition is being sent.
7	Media and status	Enter the applicable code.

Card Column	Field Legend	Explanation
8-22	Manufacturer's code and part number	Enter the Federal Supply Code for Manufacturers (FSCM) and the part number, if known. If the FSCM and part number exceed 15 positions, enter the FSCM and entire part number in data block 1 of the "Identification Data" section. If only the FSCM or part number is known, leave Card Columns 8-22 blank and enter the FSCM or part number in data block 1 of the "Identification Data" section.
23-24	Unit of issue	Enter the two-position alphabetical unit of issue for the item requisitioned.
25-29	Quantity	Enter the requested quantity.
30-35	Requisitioner	Enter the service designator and unit identification code of the chargeable activity for which material is being requisitioned.
36-39	Date	Enter the Julian data on which the request is submitted.
40-43	Serial number	Enter the serial number of the request.
44	Demand code	Enter the appropriate demand code.
45-50	Supplementary address	Enter the service designator code and UIC of "ship to/bill to" activity; or enter Y and local control code when desired; or leave blank.
51	Signal	Enter the appropriate signal code.
52-53	Fund code	Enter the appropriate fund code.
54	Distribution code	Enter the monitoring activity code if applicable, otherwise leave blank.
55-56		Leave blank.
57-59	Project code	Enter the appropriate project code if applicable.
60-61	Priority designator	Enter the authorized priority designator.
62-64	Required delivery date	Enter the required deliver date in accordance with priority and need, if appropriate.
65-66	Advice code	Enter the appropriate advice code or leave blank.
74-80	Extended price	Enter the total estimated price.

Data Block	Explanation
1	Enter the FSCM and part number of the item requested when both the FSCM and complete part number cannot be included in Card Columns 8-22. When only the FSCM is known, line out "Part No." from the data block caption and enter the FSCM; when only the part number is known, line out "FSCM" from the data block caption and enter the part number. When any entry is included in data block 1, leave Card Columns 8-22 blank.
2	Enter the name of the manufacturer of the item requested; also the manufacturer's address if known.
3	Enter the title, edition, and page number of the manufacturer's catalog in which the requested item is described.
4	Enter the name of the issuing office, number, and date of any technical order, note, bulletin, etc., which will assist in identification of the requested item.
5	Enter the title, edition, and page number of any Navy or manufacturer's technical manual which will assist in the identification of the requested item.
6	Enter the name of the item requested.
7	Enter a detailed description of the requested item, other than the name, color, and size which are to be included in data blocks 6, 7a, and 7b respectively. (If an electronic item is requested, include the circuit symbol number if applicable.)
8	Enter the name of the component/equipment (preferably the component) in which the requested item is used, and the name of the manufacturer of the component/equipment.
8a through 8d	Enter the make (or type), model number, series, and serial number, respectively, of the component/equipment indicated in data block 8.
9	Enter any additional technical information which will assist in positive identification of the requested item, such as the applicable Allowance Parts List/Change in Designation (APL/CID) number, Equipment Identification Code (EIC) number, drawing number, piece number, service application, contract number, military specification number, and any component/equipment nameplate data not included in data blocks 8 through 8d. When a component is indicated in data block 8 in lieu of an equipment, enter a brief description of the next higher assembly or the parent equipment in this data block. If the requested item can also be identified by a permanent "LL" coded NICN (see NAVSUP P-485), enter the NICN under a typed "ADDITIONAL ITEM DATA" caption. When a fund code is not assigned for entry in Card Columns 52-53, enter complete accounting data to effect procurement of the item desired.

APPENDIX IV

SURVEYS

The information contained in this appendix is not subject to NRCC or advancement in rate exam questions for advancement to PH3 or PH2. It is, however, subject to advancement in rate exam questions for advancement to PH1 and PHC. It is presented in this appendix rather than in the text to preserve continuity of the subject in the text.

The information on surveys is presented in this text to help all PHs perform their jobs better.

A survey is the procedure required when Navy property (except incoming shipments) is lost, damaged, or destroyed.

The purpose of a survey is to determine the responsibility for the lost, damaged, or destroyed property and to determine the actual loss to the Government. To make a true determination, the facts surrounding the loss or damage must be *thoroughly* researched. This research should not be limited to simply verifying statements of interested parties, but must be broad enough to ensure that the interests of the Navy as well as the rights of the individuals or Navy activities concerned are fully protected. A review is required to prove or refute statements of interested persons and is necessary to place responsibility where it belongs.

If you are ever involved in a survey report or investigation, refer to *Afloat Supply Procedures,* NAVSUP Publication 485, and *Supply Ashore,* NAVSUP Publication 1, Volume II, for specific information regarding your responsibilities and rights.

SURVEY PROCEDURES

The forms used in connection with survey procedures are:

- GPLD (Government Property Lost or Damaged) Survey Certificate (DD Form 2090).

- Report of Survey (DD Form 200).

The DD Form 2090 is used when no personal responsibility for the loss, damage, or destruction of the property is evident. The DD Form 200 is used when personal responsibility is evident, or if the reviewing authority does not approve the DD Form 2090, or if the commanding officer or higher authority so directs.

DD Form 2090 is normally prepared by the person who conducted *further* research into the circumstances of the lost or damaged property. DD Form 200 is usually initiated by the person accountable or responsible for the property in question. When circumstances warrant, such as when there is an indication of criminal action or gross negligence, the commanding officer may appoint a surveying officer or survey board to investigate the circumstances of the lost, damaged, or destroyed property.

PRELIMINARY RESEARCH

Immediately upon the discovery of the loss, damage, or destruction of Government property, the department head or division officer concerned will do preliminary research to determine if there is any evidence of negligence, willful misconduct, or deliberate unauthorized use of the property in question. If the preliminary research fails to

GPLD *(GOVERNMENT PROPERTY LOST OR DAMAGED)* SURVEY CERTIFICATE

1. TO *(Name and Address of Reviewing Authority)*:	2. FROM *(Name and address of Activity assigned responsibility for GPLD)*:	3. NAME AND GRADE OF PERSON PERFORMING OR DIRECTING RESEARCH
		4. VOUCHER NUMBER

5. I certify that the ☐ lost ☐ damaged items described below was not caused by ☐ simple ☐ gross negligence, willful misconduct or deliberate unauthorized use. I further certify that the loss of or damage to the items occurred under the circumstances described herein.

6. NATIONAL STOCK NO. OR MANUFACTURERS PART NO.	7. NOMENCLATURE	8. QUANTITY	9. UNIT OF ISSUE	10. UNIT COST	11. EXTENDED COST
12. TOTAL COST OF LISTED ITEMS →					

13. CIRCUMSTANCES OF LOSS OR DAMAGE

14. TYPED NAME & GRADE OF ACCOUNTABLE/RESPONSIBLE OFFICER	14a. SIGNATURE	14b. DATE

THIS PORTION TO BE COMPLETED BY REVIEWING AUTHORITY AND RETURNED TO ACTIVITY INDICATED IN ITEM NO. 2

15. I have reviewed the evidence pertaining to the loss or damage and ☐ agree ☐ do not agree that the loss or damage to the property was not due to ☐ simple ☐ gross negligence, willful misconduct, or deliberate unauthorized use. The following action is authorized:

☐ a. An inventory adjustment for the property which was not lost through ☐ simple ☐ gross negligence, willful misconduct, or deliberate unauthorized use.

☐ b. Repair the damaged property and charge to O&M/stock fund as fair wear and tear as damage was not caused by gross negligence, willful misconduct, or deliberate unauthorized use.

☐ c. The circumstances surrounding the loss or damage warrant the processing of a report of survey, DD Form 200, to be to be initiated immediately.

☐ d. Other action (Specify): ______________________________

16. TYPED NAME & GRADE OF REVIEWING OFFICER	16a. SIGNATURE	16b. DATE

U.S. GOVERNMENT PRINTING OFFICE. 1978—703-173/5104 2-1

REPORT OF SURVEY					1. DATE		2. SURVEY NUMBER
3. CLASS OF PROPERTY	4. STOCK RECORD ACCOUNT OR OTHER PROPERTY RECORD AND STATION						
5. ACCOUNTABLE OR RESPONSIBLE OFFICER *(Name, grade, SSN and designation)*							
6. NATIONAL STOCK NUMBER	7. DESCRIPTION		8. QUANTITY	9. UNIT PRICE	10. TOTAL COST		11. DISPOSITION
	RECOMMENDED PECUNIARY CHARGE →		12. FOR LOSS		13. FOR DAMAGE		
14. DATE AND CIRCUMSTANCES							

15.	16.	18. THIS SPACE RESERVED FOR ACTION BY AUTHORITY OF:
AFFIDAVIT I do solemnly swear *(or affirm)* that *(to the best of my knowledge and belief)* the articles of public property shown above and/or on attached sheets were lost, destroyed, damaged, or worn out in the manner stated, while in the public service.	**CERTIFICATE** I certify that the loss, destruction, damage, or unserviceability of the articles of public property shown above, and/or on attached sheets, was caused in the manner stated and without fault or neglect on my part, and that each article listed with a view to elimination by destruction has been examined by me personally, has never been previously condemned, and is, in my opinion, worthless for further public use.	
SIGNATURE	SIGNATURE *(Accountable or Responsible Officer)*	
NAME, GRADE, SSN AND ORGANIZATION	NAME, GRADE, SSN AND ORGANIZATION	
SUBSCRIBED AND SWORN TO *(or affirmed)* BEFORE ME AT THIS DAY OF 19	17. HEADQUARTERS	
	STATION / DATE	
SIGNATURE	TO	
NAME, GRADE, SSN AND ORGANIZATION OR TITLE; IF NOTARY PUBLIC, AFFIX SEAL	YOU ARE APPOINTED SURVEYING OFFICER BY ORDER OF SIGNATURE OF ADJUTANT/EXECUTIVE OFFICER & DATE	19. PROPERTY VOUCHER NUMBER

DD FORM 1 DEC 73 200 EDITION OF 1 APR 73 MAY BE USED UNTIL EXHAUSTED

S/N 0102-LF-000-2000

Certificate (DD Form 2090) can be initiated. If, however, the results of the research show positive evidence of negligence, willful misconduct, or unauthorized use, a Report of Survey (DD Form 200) will be used—*unless* the value does not exceed $500 *and* the responsible person voluntarily consents (in writing) to pay for the property. If the value does not exceed $500, DD Form 2090 can be used, even when negligence, willful misconduct, or unauthorized use is involved and the responsible person will reimburse the Government. In the case of voluntary reimbursement in excess of $500, DD Form 200 is used.

WHEN FURTHER RESEARCH ACTION IS NOT REQUIRED

Further research action, beyond preliminary research, into the circumstances of the loss, damage, or destruction of Government property is not required, when in the opinion of the commanding officer, negligence is not indicated or that for known reasons, negligence or responsibility can't be determined and that research under those conditions would be an unnecessary administrative burden. Research action is not usually required when an individual accepts responsibility for the loss, damage, or destruction of the property and offers to reimburse the Government.

The commanding officer may permit the use of investigative reports required by higher authority (such as MLSR reports) instead of research when:

- There is no death or injury.
- The total property loss, damage, or destruction does not exceed $200.
- There is no possible claim against the Government.

FURTHER RESEARCH

If preliminary research shows evidence of possible negligence, willful misconduct, or unauthorized use, the incident is considered unresolved and further research into the incident will be conducted. when the incident involves:

- Sensitive items, such as reclaimed silver, regardless of the value.
- Classified items regardless of the value.
- Pilferable items when the discrepancy is $500 or more.
- An indication or suspicion of fraud, theft, or negligence.
- Missing controlled equipage.

Further research is conducted to:

- Relieve the person accountable for the items in question of responsibility.
- Substantiate adjustment of stock records.
- Identify problem areas.
- Identify corrective action.

Further research will be conducted by a person who is not supervised by the person who is accountable for the equipment or items in question; that is, the person who signed for custody of the items, etc. Further research will include, as a minimum, the following actions:

- Review for adequacy of procedures to protect property.
- Determination of procedural compliance.
- Determination of the nature of personal responsibility, if any.
- Determination of negligence, if any
- Recommendation of corrective action.

SURVEYING OFFICER

The surveying officer is usually appointed by the commanding officer. The surveying officer will *usually* be a commissioned officer, warrant

officer, or enlisted member in paygrade E8 or E9. The surveying officer is designated in writing by the appointing authority by completing item 17 on the DD Form 200. An individual who is accountable or responsible for the items of property in question cannot be appointed as the surveying officer.

RESPONSIBILITIES AND DUTIES

The research conducted by the surveying officer is an extremely critical phase of the survey system. The evidence and data presented by the surveying officer and recorded in his findings are evaluated together with the recommendations in succeeding reviews. In formulating recommendations and decisions, higher authorities depend almost entirely on the information the surveying officer includes in the Report of Survey.

A surveying officer must be free of bias or prejudice and not start his research with predetermined ideas as to the cause or the responsibility of the loss or damage. A thorough and impartial review develops the actual facts and circumstances, not necessarily as they were reported to the surveying officer, but as they actually are.

The surveying officer should be able to make an accurate and concise statement in his findings as to whether or not the loss, damage, or destruction was due to gross negligence, willful misconduct, or deliberate unauthorized use. After the findings are recorded, a logical and reasonable recommendation will be made to place responsibility.

The surveying officer should conduct his review as quickly as possible and, if there is a delay of 45 days or more, inform the appointing authority in writing of the reasons for the delay.

If, at any time, in the course of his investigation into the loss, damage, or destruction of Government property, it appears that criminal prosecution under the UCMJ or Federal law might be in order, no further statements should be taken from any person, whether suspect or witness, before discussing the case with a legal officer.

Surveying Officer's Findings

The surveying officer should record his findings and the factors upon which he based his recommendations on the DD Form 200 and/or a plain sheet of paper attached to the DD Form 200. The conclusions he reached MUST be based upon the evidence presented. He should:

- Ensure the findings and recommendations do not contain unsubstantiated opinions or stereotyped phrases.

- Ensure the findings either sustain or refute the statements which are part of the report.

- Include, for administrative purposes only, any financial indebtedness charge against an individual in connection with the survey.

After completing the investigation, all copies of the report and attachments are returned to the appointing authority/reviewing authority (normally the commanding officer). The surveying officer is not relieved from his detail as the surveying officer until final action is taken. The commanding officer may approve the findings of the surveying officer or make his own recommendations. Or he may, if he does not approve the report, appoint a survey board.

SURVEY BOARD

The commanding officer may appoint a survey board for the specific purpose of investigating Reports of Survey.

A survey board may consist of two or more persons. Normally, commissioned or warrant officers are appointed, but qualified enlisted personnel in paygrades E8 and E9 may be appointed if circumstances warrant.

The survey board consolidates the functions of the appointing authority and the survey officer. Its objective is to relieve the commanding officer from the administrative burdens involved in the Report of Survey procedures.

FINAL ACTION

The commanding officer is designated to take final action on DD Form 200 except when:

- The property value or cost of repair exceeds $10,000 or financial responsibility is involved.

• The DD Form 200 lists property for which the commanding officer is personally responsible.

When the commanding officer is not authorized to take final action, or for any reason desires to forward the report to higher authority for action, he makes suitable recommendations and forwards the report. If the commanding officer wants to approve the last recommendation, he may do so by inserting "Approved" in item 29 of the DD Form 200.

INDEX

D

E

F

G

H

I

K

L

M

N

O

P

NAVY PHOTOGRAPHER'S MATE
MODULE 3

NAVEDTRA 373-03-45-83

Prepared by the Naval Education and Training Program Development Center, Pensacola, Florida

Your NRCC contains a set of assignments and perforated answer sheets. The Rate Training Manual, Navy Photographer's Mate Module 3 NAVEDTRA 373-03-45-83, is your textbook for the NRCC. If an errata sheet comes with the NRCC, make all indicated changes or corrections. Do not change or correct the textbook or assignments in any other way.

HOW TO COMPLETE THIS COURSE SUCCESSFULLY

Study the textbook pages given at the beginning of each assignment before trying to answer the items. Pay attention to tables and illustrations as they contain a lot of information. Making your own drawings can help you understand the subject matter. Also, read the learning objectives that precede the sets of items. The learning objectives and items are based on the subject matter or study material in the textbook. The objectives tell you what you should be able to do by studying assigned textual material and answering the items.

At this point you should be ready to answer the items in the assignment. Read each item carefully. Select the BEST ANSWER for each item, consulting your textbook when necessary. Be sure to select the BEST ANSWER from the subject matter in the textbook. You may discuss difficult points in the course with others. However, the answer you select must be your own. Remove a perforated answer sheet from the back of this text, write in the proper assignment number, and enter your answer for each item.

Your NRCC will be administered by your command or, in the case of small commands, by the Naval Education and Training Program Development Center. No matter who administers your course you can complete it successfully by earning a 3.2 for each assignment. The unit breakdown of the course, if any, is shown later under Naval Reserve Retirement Credit.

WHEN YOUR COURSE IS ADMINISTERED BY LOCAL COMMAND

As soon as you have finished an assignment, submit the completed answer sheet to the officer designated to grade it. The graded answer sheet will not be returned to you.

If you are completing this NRCC to become eligible to take the fleetwide advancement examination, follow a schedule that will enable you to complete all assignments in time. Your schedule should call for the completion of at least one assignment per month.

Although you complete the course successfully, the Naval Education and Training Program Development Center will not issue you a letter of satisfactory completion. Your command will make an entry in your service record, giving you credit for your work.

WHEN YOUR COURSE IS ADMINISTERED BY THE NAVAL EDUCATION AND TRAINING PROGRAM DEVELOPMENT CENTER

After finishing an assignment, go on to the next. Retain each completed answer sheet until you finish all the assignments in a unit (or in the course if it is not divided into units). Using the envelopes provided, mail your completed answer sheets to the Naval Education and Training Program Development Center where they will be graded and the score recorded. Make sure all blanks at the top of each answer sheet are filled in. Unless you furnish all the information required, it will be impossible to give you credit for your work. The graded answer sheets will not be returned.

The Naval Education and Training Program Development Center will issue a letter of satisfactory completion to certify successful completion of the course (or a creditable unit of the course). To receive a course-completion letter, follow the directions given on the course-completion form in the back of this NRCC.

You may keep the textbook and assignments for this course. Return them <u>only</u> in the event you disenroll from the course or otherwise fail to complete the course. Directions for returning the textbook and assignments are given on the book-return form in the back of this NRCC.

PREPARING FOR YOUR ADVANCEMENT EXAMINATION

Your examination for advancement is based on the Occupational Standards for your rating as found in the MANUAL OF NAVY ENLISTED MANPOWER AND PERSONNEL CLASSIFICATIONS AND OCCUPATIONAL STANDARDS (NAVPERS 18068). These Occupational Standards define the minimum tasks required of your rating. The sources of questions in your advancement examination are listed in the BIBLIOGRAPHY FOR ADVANCEMENT STUDY (NAVEDTRA 10052). For your convenience, the Occupational Standards and the sources of questions for your rating are combined in a single pamphlet for the series of examinations for each year. These OCCUPATIONAL STANDARDS AND BIBLIOGRAPHY SHEETS (called Bib Sheets), are available from your ESO. Since your textbook and NRCC are among the sources listed in the bibliography, be sure to study both as you take the course. The qualifications for your rating may have changed since your course and textbook were printed, so refer to the latest edition of the Bib Sheets.

NAVAL RESERVE RETIREMENT CREDIT

This course is evaluated at 16 Naval Reserve retirement points which will be credited upon satisfactory completion of each creditable unit as shown below:

Unit 1 - 12; Assignments 1 through 6

Unit 2 - 4; Assignments 7 through 12

These points are creditable to personnel eligible to receive them under the current directives governing personnel.

COURSE OBJECTIVE

While completing this nonresident career course you will demonstrate an understanding of course materials by correctly answering items on the following:

- The requirements of an efficient, mission oriented photographic facility including workflow, physical plant layout, and equipment requirements for the efficient, cost effective operation of a photo lab to bring about the production of high quality photographic products.
- Hand processing black and white and color film to produce quality negatives and positives which are free of film processing faults.
- The principles and techniques associated with black and white and color printing--both contact and projection.
- Machine processing of photographic products and the general requirements of equipment maintenance.
- Audiovisual administration and supply procedures necessary for the efficient accomplishment of the unit's assigned mission.

While working on this correspondence course, you may refer freely to the text. You may seek advice and instruction from others on problems arising in the course, but the solutions submitted must be the result of your own work and decisions. You are prohibited from referring to or copying the solutions of others, or giving completed solutions to anyone else taking the same course.

Naval courses may include a variety of questions -- multiple-choice, true-false, matching, etc. The questions are not grouped by type; regardless of type, they are presented in the same general sequence as the textbook material upon which they are based. This presentation is designed to preserve continuity of thought, permitting step-by-step development of ideas. Some courses use many types of questions, others only a few. The student can readily identify the type of each question (and the action required) through inspection of the samples given below.

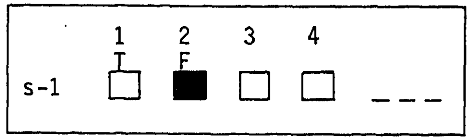
MULTIPLE-CHOICE QUESTIONS

Each question contains several alternatives, one of which provides the best answer to the question. Select the best alternative, and blacken the appropriate box on the answer sheet.

SAMPLE

s-1. The first person to be appointed Secretary of Defense under the National Security Act of 1947 was
1. George Marshall
2. James Forrestal
3. Chester Nimitz
4. William Halsey

Indicate in this way on the answer sheet:



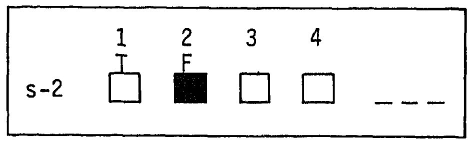
TRUE-FALSE QUESTIONS

Mark each statement true or false as indicated below. If any part of the statement is false the statement is to be considered false. Make the decision, and blacken the appropriate box on the answer sheet.

SAMPLE

s-2. Any naval officer is authorized to correspond officially with any systems command of the Department of the Navy without his commanding officer's endorsement.

Indicate in this way on the answer sheet:



MATCHING QUESTIONS

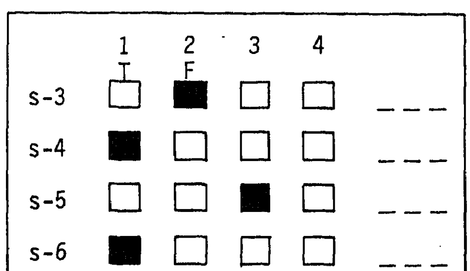
Each set of questions consists of two columns, each listing words, phrases or sentences. The task is to select the item in column B which is the best match for the item in column A that is being considered. Items in column B may be used once, more than once, or not at all. Specific instructions are given with each set of questions. Select the numbers identifying the answers and blacken the appropriate boxes on the answer sheet.

SAMPLE

In questions s-3 through s-6, match the name of the shipboard officer in column A by selecting from column B the name of the department in which the officer functions.

A	B
s-3. Damage Control Assistant	1. Operations Department
s-4. CIC Officer	2. Engineering Department
s-5. Disbursing Officer	3. Supply Department
s-6. Communications Officer	

Indicate in this way on the answer sheet:



Assignment 1

diovisual Facilities

xtbook: Pages 1-1 through 1-18

In this course you will demonstrate that learning has taken place by correctly answering raining items. The mere physical act of indicating a choice on an answer sheet is not in itself mportant; it is the mental achievement, in whatever form it may take, prior to the physical act nat is important and toward which course learning objectives are directed. The selection of the orrect choice for a course training item indicates that you have fulfilled, at least in part, ne stated objective(s).

The accomplishment of certain objectives, for example, a physical act such as drafting a emo, cannot readily be determined by means of objective type course items; however, you can emonstrate by means of answers to training items that you have acquired the requisite knowledge o perform the physical act. The accomplishment of certain other learning objectives, for xample, the mental acts of comparing, recognizing, evaluating, choosing, selecting, etc., may e readily demonstrated in a course by indicating the correct answers to training items.

The comprehensive objective for this course has already been given. It states the purpose f the course in terms of what you will be able to do as you complete the course.

The detailed objectives in each assignment state what you should accomplish as you progress nrough the course. They may appear singly or in clusters of closely related objectives, as ppropriate; they are followed by items which will enable you to indicate your accomplishment.

All objectives in this course are learning objectives and items are teaching items. They oint out important things, they assist in learning, and they should enable you to do a better ob for the Navy.

This self-study course is only one part of the total Navy training program; by its very ature it can take you only part of the way to a training goal. Practical experience, schools, elected reading, and the desire to accomplish are also necessary to round out a fully meaningful raining program.

Learning Objective: Identify elements that will ensure efficient workflow patterns for Navy photo labs. Recognize the factors to be considered in photo lab design which contribute to efficient production. Identify or select factors that will indicate an understanding of the importance of safety in our Navy photo labs.

---

1. Which of the following areas/equipment are common to all photo labs?
   1. Automatic processing machines
   2. Portrait studios
   3. Copy cameras
   4. Darkrooms

1-2. Which of the following functions is a primary mission of Navy photo labs?
   1. Providing sailors with photography
   2. Providing official photography
   3. Processing film
   4. Training photographers so they can perform efficiently in time of national emergency

1-3. What is the "starting point" for most photo lab work?
   1. Job control
   2. Shooting crew
   3. Film processing

1-4. The film processing crew has the capability of processing 78 4x5 films per hour while the print crew can produce 1 print each from 50 negatives per hour. Considering the number of negatives coming out of the film processing room per hour, how many prints can be produced in an 8-hour period?
   1. 224
   2. 624

1-5. For a list of authorized production equipment for your ship's photo lab, what publication should you consult?
1. OPNAVINST 4790.2
2. OPNAVINST 5290.1
3. NAVAIR 00-35QP Series
4. NAVAIR 10700/1

● Questions 1-6 and 1-7 are to be judged True or False.

1-6. When you have a request for audiovisual support which your photo lab cannot fulfill because the proper equipment is not available, you must send the work to one of the fleet audiovisual commands or the Naval Audiovisual Center and not to a commercial lab.

1-7. No part of a darkroom should ever be painted black.

1-8. Why should everything in a flim processing darkroom always be in "its place?
1. To prevent damage to the film being processed
2. To facilitate rapid inventory
3. So equipment will be easy to find in the dark
4. So anyone working in the darkroom for the first time will know where to look for the processing equipment

1-9. What type of safelight produces a relatively great amount of visible light yet is suitable for use with most black and white printing papers?
1. OA
2. OC
3. No. 2
4. Sodium vapor

1-10. Which of the following safelight filters can be used with orthochromatic film?
1. No. 1A
2. No. 2
3. OC
4. Sodium vapor

● Questions 1-11 and 1-12 are to be judges True or False.

1-11. Color photographic printing paper should not normally be exposed to safelight illumination.

1-12. Because all Navy photographers must have a security clearance, it is not necessary to have door locks on a security darkroom.

1-13. How long should you remain in a darkened film loading room whjen examining it for light leaks?
1. A minimum of 10 minutes
2. At least 1 hour
3. Not more than 10 minutes
4. Not more than 1 hour

● Questions 1-14 and 1-15 are to be judged True or False.

1-14. Darkrooms can be provided with entryway doors, light locks, light traps or curtains, except that curtains cannot be used for the entryway to a film processing room.

1-15. For safety reasons all nondarkrooms in an audiovisual facility should have windows.

1-16. A room where color prints will be evaluated should have walls painted with which of the following colors?
1. Two-tone; beige and cream
2. Bright white
3. Jet black
4. Light gray

1-17. What should be the approximate temperature of a film drying room?
1. 68°F
2. 75°F
3. 100°F
4. 140°F

1-18. What room in a photo lab is considered the center of photographic production?
1. The job control desk room
2. The production PO's office
3. The supply room
4. The finishing room

1-19. Which of the following color temperatures is most suitable for evluataing color prints?
1. 2500°K
2. 3500°K
3. 4500°K
4. 5500°K

1-20. What type of floor tile is preferred for the chemical mixing room?
1. Asphalt
2. Vinyl
3. Rubber
4. Ceramic

● Question 1-21 is to be judged True or False.

1-21. Smoking must not be permitted in the chemical mixing room.

1-22. Generally speaking, which of the following temperatures would be best for the storage of photographic chemicals?
1. -10°F
2. 35°F
3. 70°F
4. 100°F

1-23. What type of container should be used for the storage of corrosive acid?
1. Soft-pack plastic
2. Glass
3. Thick-walled glass
4. No. 316 stainless steel

● Questions 1-24 and 1-25 are to be judged True or False.

1-24. Aboard ship, when bottles of chemicals are lashed in small lots, it is still necessary to lash them to the shelves.

1-25. When there is not enough cold storage space for both black and white and color sensitized material, cold storage preference is given to color materials.

1-26. What is the best range of relative humidities for the storage of unexposed film?
1. 30 to 40 percent
2. 40 to 50 percent
3. 50 to 60 percent
4. 60 to 70 percent

1-27. Which of the following temperatures is best for the long-term storage of unexposed color film?
1. -05°F
2. 32°F
3. 40°F
4. 50°F

1-28. How often should field day be held in our Navy photo labs and on which of the following days should it be held?
1. Biweekly on Tuesdays
2. Triweekly on Wednesdays
3. Weekly on Thursdays
4. Daily on Fridays

● Question 1-29 is to be judged True or False.

1-29. When the chief in charge of the photo lab secures the lab during normal working hours for weekly field days, the chief has probably forgotten or does not care that the whole purpose for the lab is being able to serve our fellow shipmates and provide them with official photography.

1-30. Which of the following publications is most adaptable to shipboard safety?
1. OPNAVINST 5100.19
2. NAVMAT P-5100

● Question 1-31 is to be judged True or False.

1-31. Navy photo labs are susceptible to the provisions of the Occupational Safety and Health Act of 1970.

1-32. Which of the following persons are responsible for observing all safety precautions?
1. Audiovisual managers
2. Work center supervisors
3. Darkroom workers
4. All of the above

1-33. You see a shipmate leaning on the glass of a light table. You must immediately notify which of the following people?
1. The audiovisual manager
2. The production PO
3. The safety PO
4. The person leaning on the glass

1-34. When should rubber gloves used to handle acids be washed?
1. Before you put them on
2. After you put them on and before handling the acid
3. After you take them off
4. Before you take them off

1-35. A complete change of air in a film processing room should take place at least every how many minutes?
1. 12
2. 9
3. 7
4. 4

1-36. A photo lab should be maintained at approximately (a) what temperature and (b) what relative humidity?
1. (a) 68°F (b) 40 percent
2. (a) 75°F (b) 45 percent
3. (a) 68°F (b) 50 percent
4. (a) 75°F (b) 55 percent

1-37. Thermostatic temperature regulating water mixing valves should have an accuracy of ± how many degrees?
1. 1.0
2. 2.0
3. 3.0
4. 0.5

1-38. The hot water in your lab has a milky appearance. This may be an indication that incoming cold water has a temperature of about how many degrees Fahrenheit?
1. 100
2. 75
3. 55
4. 47

1-39. The water pressure in the photo lab should be approximately how many psi?

1. 50
2. 20
3. 30
4. 40

1-40. Washing prints without the use of a hypo clearing agent uses 146 gallons of water. If a hypo clearing agent is used, approximately how many gallons of water will be required to wash the same prints?

1. 25
2. 50
3. 75
4. 100

1-41. You have washed negatives in seawater. The final freshwater wash should be for how many minutes?

1. 2
2. 3
3. 5
4. 10

Assignment 2

Chemical Mixing

Textbook: Pages 2-1 through 2-17

Learning Objective: Appreciate the importance of accuracy in chemical mixing. Identify the proper storage conditions for both chemicals and solutions. Select chemical mixing and storage equipment made of materials which will not affect or be affected by photographic chemicals. Accurately measure both dry chemicals and liquids using scales and graduates. Correctly measure solution temperatures. Determine the specific gravity and pH of solutions. Properly operate chemical mixers. Convert weight, volumes, and temperatures from one measurement system to another. Follow chemical mixing and safety rules and instructions.

2-1. Why is it important to use only correctly mixed chemicals when processing film?

1. Using improperly mixed chemistry is always dangerous to the user's health
2. Improperly mixed chemistry may ruin the film from an important mission
3. The mixing equipment will be damaged

2-2. For the storage of unmixed chemicals, what should be (a) the approximate temperature, and (b) the relative humidity?

1. (a) 20°F (b) 68 percent
2. (a) 40°F (b) 75 percent
3. (a) 68°F (b) 20 percent
4. (a) 75°F (b) 40 percent

2-3. Storage vessels made of what material are best for storing liquid developer?

1. Hard rubber
2. Plastic
3. Glass
4. Stainless steel

● Question 2-4 is to be judged True or False.

2-4. An air space should never be left in a large bottle used for the storage of developer replenisher.

2-5. What is the purpose of floating lids used for the storage of large volumes of liquid in tanks?

1. To prevent dust from settling on the liquid surface
2. To prevent the evaporation of the solution
3. To prevent the unauthorized use of the solution
4. To prevent aerial oxidation of the solution

2-6. The "signature" of a freshly mixed solution is not right. What does this indicate?

1. Unsatisfactory results might be produced
2. The chemicals may have been mixed wrong
3. Both 1 and 2 above
4. The solution must be discarded

2-7. What type of stainless steel is recommended for the construction of photographic chemical handling equipment?

1. 133
2. 316
3. 361
4. 631

2-8. A film processing tank made from which of the following materials may cause developer oxidation when in contact with developer?

1. Brass
2. Nickel
3. Aluminum
4. All of the above

● Question 2-9 is to be judged True or False.

2-9. If washed well between uses, wooden paddles make excellent chemical mixing

2-10. Which, if any, of the following sizes of mixing tanks should be used to mix 32 ounces of liquid?
1. 5 gallons
2. 30 gallons
3. 128 ounces
4. None of the above

2-11. You are to use a scale to measure 4 ounces of chemical. The scale should have an accuracy of ± how many grains?
1. One
2. Two
3. Three
4. Four

• Questions 2-12 through 2-14 are to be judged True or False.

2-12. When you use a scale with separate balance weights, the chemical being weighed should be placed on the left-hand pin.

2-13. Chemicals should always be weighed in the order they are listed in formulas.

2-14. A graduate should be used to measure a dry chemical.

2-15. Which of the following units of measure is NOT part of the small U.S. liquid measurement system?
1. Liter
2. Gram
3. Ounce
4. Gallon

2-16. When you measure acids with a graduate, the graduate should be made of what type(s) of material?
1. Plastic
2. Glass only
3. Stainless steel only
4. Glass or stainless steel

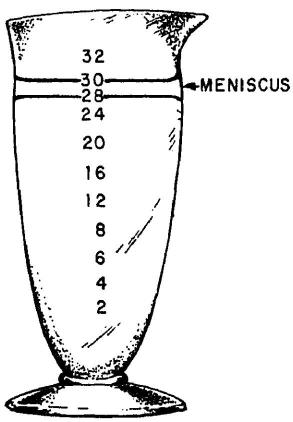


Figure 2A

• In answering question 2-17, refer to figure 2A. NOTE: For the purpose of question 2-17, the meniscus has been exaggerated in the drawing.

• Question 2-17 is to be judged True or False.

2-17. The graduate contains 28 ounces of liquid.

2-18. What type of instrument is used to measure the temperature of a liquid?
1. pH meter
2. Hydrometer
3. Thermometer

2-19. What type of instrument is used to measure the specific gravity of a solution?
1. pH meter
2. Hydrometer
3. Thermometer

• Question 2-20 is to be judged True or False.

2-20. The temperature of a solution has no bearing on the specific gravity of a solution.

2-21. The specific gravity measurement for a developer is below the standard limit. This may be an indication of which of the following faults?
1. Too much of a given chemical added
2. A foreign ingredient added
3. Too much water used
4. The chemicals not throughly mixed

2-22. A hydrometer used to measure the silver content of a fixing bath is calibrated in grams of silver per
1. ounce
2. milliliter
3. dram
4. liter

2-23. Specific gravity is a measure of liquid
1. composition
2. strength
3. opacity
4. density

2-24. What part of the meniscus, if any, formed at the hydrometer stem, indicates the ratio of the density of the solution to the density of water?
1. The top
2. The middle
3. The bottom
4. None, a hydrometer does not indicate any type of ratio

Questions 2-25 and 2-26 are to be judged True or False.

If the first specific gravity reading of a solution deviates from prescribed limits, a second reading of a new sample of the same solution should be made before conducting other tests.

A pH meter is capable of reading only the acidity of a solution.

A film developer should have which of the following pH values?
1. 3.1 to 5
2. 5.0 to 8
3. 8.0 to 12
4. 12.0 to 14

An alkali may have which of the following pH values?
1. 1
2. 5
3. 7
4. 11

A pH value of 7 is
1. acid
2. alkali
3. neutral

A pH value of 2 is how many times stronger than a pH value of 3?
1. 1
2. 2
3. 10
4. 100

Question 2-31 is to be judged True or False.

A pH value of 3 is 1/10 as strong as a pH value of 1.

A pH value of 9 is how many times stronger than a pH of 8?
1. 1
2. 2
3. 10
4. 100

A pH value of 13 is how many times stronger than a pH value of 8?
1. 100
2. 1,000
3. 10,000
4. 100,000

Question 2-34 is to be judged True or False.

The pH value of a solution cannot be determined with litmus paper.

2-35. The solution used to standardize a pH meter is known as what type of solution?
1. Acid
2. Neutral
3. Alkali
4. Buffer

2-36. You will be measuring the pH value of a fixing bath. The buffer solution you select to standardize the pH meter should have which of the following pH values?
1. 13
2. 9
3. 7
4. 4

2-37. You will be measuring the pH value of a developer. The sample of developer to be measured is at 74°F. The desired pH value is 9. What should be the temperature of the buffer used to standardize the pH meter?
1. 92°F
2. 83°F
3. 74°F
4. 65°F

Question 2-38 is to be judged True or False.

2-38. The pH value of a given type of developer must always be the same from one mix to the next mix in order to give consistent processing results.

2-39. You have set up an impeller-type mixer to mix a solution, but you have improperly adjusted the clamp so that the shaft is vertical and in the center of the container. What will probably be the result of this maladjustment?
1. The motor bearings will be ruined
2. Too much air will be whipped into the solution
3. The mixer will vibrate enough to damage itself
4. The solution will be churned from top to bottom rather than from bottom to top

2-40. How many grams are in 1 ounce?
1. 28.3
2. 56.6
3. 113.2
4. 226.4

2-41. How many kilograms are in 3 pounds, 8 ounces?
1. 1.575
2. 0.39375
3. 3.15
4. 0.7875

2-42. How many liters are in 192 ounces?
1. 5.7
2. 11.4
3. 22.8
4. 45.6

2-43. 68°F is equal to how many degrees Celsius?
1. 10
2. 20
3. 30
4. 40

2-44. A formula you are mixing calls for the water to be 23.8°C. This is equal to how many degrees Fahrenheit?
1. 18.75
2. 37.5
3. 75.0
4. 150.0

2-45. A formula you are mixing calls for one part of solution B and three parts of solution A. You will use 1 gallon of solution B. How many ounces of solution A will you need?
1. 42.6
2. 96.0
3. 384.0
4. 448.0

● Questions 2-46 and 2-47 are to be judged as True or False.

2-46. It is permissible to mix photographic chemicals in a photographic print room when there is a complete change of air every 3 minutes.

2-47. Stainless steel is the most suitable construction material for chemical mixing equipment because photographic chemicals will not corrode it.

2-48. You need 32 ounces of developer solution and the only size package of dry developer chemicals you have is to make 128 ounces. Should you mix the entire package to make 128 ounces and why?
1. Yes; if only part of the package is mixed some ingredients may be left out of the resulting solution
2. Yes; if only part of the package is used the resulting solution will not develop film
3. No; dry packaged chemicals are homogenized
4. No; dry packaged chemicals are formulated to be mixed either in part or in whole

● Questions 2-49 and 2-50 are to be judged True or False.

2-49. Just as you should always add acid to water you should always add water to dry chemicals.

2-50. You should never add another chemical to a solution until the previous chemical is completely dissolved.

2-51. Which of the following data should always be included on the label of a tank of photographic solution?
1. The water mixing temperature
2. The name of the chem-mix supervisor
3. The antidote
4. The date mixed

2-52. The final volume of developer you need is 10 pints. How many ounces of water should you start with?
1. 20
2. 40
3. 80
4. 160

2-53. At which of the following temperatures are developers usually mixed?
1. 10.5°C
2. 20.0°C
3. 41.9°C
4. 83.8°C

2-54. You are mixing prepared chemicals from bottles. As each liquid is added to the solution should you rinse the bottle and add the rinse water to the solution and why?
1. No; this may contaminate the solution
2. No; this may dilute the solution
3. Yes; this will cause the solution to be stronger and last longer
4. Yes; this is done to get all the liquid chemical out of the bottle

2-55. The chemical being dissolved is called the (a) and the solution to which it is being added is called the (b) .
1. (a) solvent (b) dissolvent
2. (a) solute (b) dissolver
3. (a) solvent (b) solute
4. (a) solute (b) solvent

2-56. A solution, by definition, must contain at least how many substances?
1. One
2. Two
3. Three
4. Four

2-57. When a solution contains as much chemical as it is capable of dissolving, it is said to be
1. 100-percent pure
2. fully ready
3. loaded
4. saturated

2-58. You require 7 ounces of a 12-percent solution from a dry chemical. How many grains of the dry chemical will you need?

1. 70
2. 170
3. 270
4. 370

2-59. How much dry potassium ferricyanide must you use to make 3 ounces of a 10-percent solution of potassium ferricyanide?

1. 202 grains
2. 182 grains
3. 150 grains
4. 132 grains

2-60. You must mix 20 ounces of a 28-percent solution of acetic acid from 99.5-percent glacial acetic acid. (a) Approximately how many ounces of glacial acetic acid and (b) how many ounces of water will be required?

1. (a) 4.0 (b) 16.0
2. (a) 5.0 (b) 15.0
3. (a) 5.6 (b) 14.4
4. (a) 6.5 (b) 13.5

● Question 2-61 is to be judged True or False.

2-61. All chemicals dissolve faster in hot water than in cold water.

2-62. The "cloth bag method" is a good timesaver to use when dissolving which of the following chemicals.

1. Hypo
2. Hydroquinone
3. Metol
4. Glycin

2-63. Which of the following statements is/are true?

1. An antaidote is for emergency use only
2. Ingestion of a poisonous chemical may be induced by smoking
3. A person who has has acid spilled on him should see a doctor immediately
4. All of the above

Assignment 3

Film Processing

Textbook: Pages 3-1 through 3-8

Learning Objective: Recognize procedures to be followed and requirements for processing film and indicate the function of the various solutions used to process film.

Questions 3-1 and 3-2 are to be judged True or False.

3-1. All film development is dependent upon a solution containing soluble silver salts.

3-2. All silver halides, exposed and unexposed, in a film emulsion can be reduced to black metallic silver by development.

3-3. In the direct development film process, the exposed silver halides in a film are changed to
1. black metallic silver
2. soluble silver salts
3. dye image salts
4. gray tone dyes

3-4. What term describes the amount of silver in a film emulsion which has been reduced to black metallic silver?
1. Light-struck
2. Rate phenomenon
3. Density
4. Primary silver

3-5. What is the most important ingredient in a developer?
1. Preservative
2. Accelerator
3. Restrainer
4. Reducing agent

3-6. Which of the following ingredients in a developer has the greatest influence on image tone?
1. Reducing agent
2. Restrainer
3. Activator
4. Accelerator

3-7. What is the purpose of a preservative in a developer?
1. It preserves image tone quality
2. It retards oxidation
3. It prevents developer stain
4. Each of the above

3-8. Which of the following chemicals may be used as a preservative?
1. Hydroquinone
2. Sodium sulfite
3. Amidol
4. Pyro

3-9. What ingredient in a developer makes the solution alkaline?
1. Accelerator
2. Reducing agent
3. Preservative
4. Restrainer

Question 3-10 is to be judged True or False.

3-10. The accelerator in a developer serves two purposes, (1) it quickens gelatin swelling by chemical action and (2) it absorbs halogen elements by physical action.

3-11. A developer with which of the following pHs will probably produce a finer grain image?
1. 1
2. 5
3. 8
4. 11

3-12. What is the purpose of a restrainer in a developing solution?
1. To slow down the action of the reducing agent
2. To prevent the preservative from etching the silver grains
3. To retard the action of the accelerator
4. To reduce image contrast

Which of the following developer ingredients is effective in preventing chemical fog?
1. Metal
2. Hydroquinone
3. Potassium bromide
4. Sodium sulfite

Question 3-14 is to be judged True or False.

An ideal developing solution will cease action on a film emulsion when all the exposed silver has been developed. Kodak D-76 is such a developer.

Which of the following factors does not generally influence the choice of a developer?
1. The film size
2. The type of developing equipment used
3. The exposure conditions
4. The film's inherent characteristics

What does the term "gamma" refer to?
1. Negative image density
2. Negative image opacity
3. Negative image density ratio
4. Negative image contrast to scene contrast ratio

Question 3-17 is to be judged True or False.

When 35mm B&W film is processed in a fine grain developer, the grain structure of the negative will not be seen even in large enlargements.

Of what result is the clumping of silver grains in a negative?
1. The grain structure before development only
2. Development only
3. The grain structure before development and development

What type of developer should be used to process line copy film?
1. High contrast
2. Fine grain
3. General purpose
4. High definition

A film with which of the following ISOs would be most suitable for processing in a compensating developer?
1. 50
2. 250
3. 500
4. 1200

3-21. What effect, if any, will the byproducts of development have on the pH of a developer?
1. The pH will rise
2. The pH will fluctuate
3. The pH will drop
4. None

3-22. Which, if any, of the following actions can be taken to compensate for the excess bromide in a used developer?
1. Increase development time
2. Decrease development time
3. Add more restrainer
4. None of the above

3-23. Although increasing development time in a developer which is nearing exhaustion may produce adequate image density, why should you NOT use the developer?
1. Developing time would be excessive
2. Image contrast would be too great
3. The image may be stained
4. Image density will be too great

3-24. What is the primary purpose for using a developer replenisher?
1. To maintain solution volume
2. To maintain the composition or makeup of the solution
3. To extract used developer
4. To keep the developer activity steady

3-25. What replenishment method is used only to maintain solution volume?
1. Bleed
2. Topping off

3-26. The developer's processing characteristics will remain more constant when what replenishment method is used?
1. Bleed
2. Topping off

Question 3-27 is to be judged True or False.

3-27. The action of a developer will stop when the film is removed from the developer.

3-28. What is the purpose of a stop bath?
1. It prevents excessive film exposure
2. It stops the loss of developer due to carryover
3. It stops the action of the developer
4. It stops the film processing operation

3-29. What property of a stop bath prevents further development?
1. Its temperature
2. Its volume
3. Its penetrating action
4. Its pH

3-30. A solution with which of the following pHs should be selected as a stop bath?
1. 2
2. 5
3. 7
4. 9

3-31. Why should a stop bath be made up of weak acid?
1. To prevent damage to the film emulsion
2. To prevent nausea to darkroom workers as a result of inhaling strong acid fumes
3. To prevent corrosive action on the film processing equipment

3-32. What type of acid is (a) generally used as a stop bath, and (b) at what strength is it generally used?
1. (a) Sulfuric (b) 28 percent
2. (a) Acetic (b) 99.5 percent
3. (a) Sulfuric (b) 99.5 percent
4. (a) Acetic (b) 1 percent

3-33. What is the strength of glacial acetic acid?
1. 1 percent
2. 28 percent
3. 99.5 percent

3-34. For a normal stop bath, how many ounces of 28-percent acetic acid should you mix with 32 ounces of water?
1. 1
2. 1/2
3. 28
4. 99.5

Question 3-35 is to be judged True or False.

3-35. Once development is completed, the silver remaining in a film emulsion is no longer sensitive to light.

3-36. Which step in a film process dissolves the silver salts NOT affected by the developer?
1. Water rinse
2. Stop bath
3. Fixer
4. Wash

3-37. What silver solvent is used as the prime ingredient in a fixing bath?
1. Acetic acid
2. Glacial acetic acid
3. Sodium thiosulfate

3-38. Which of the following films will probably require the longest fixing time?
1. Fine grain
2. Normal grain
3. Coarse grain

3-39. A fixing bath should normally contain a concentration of about what percent hypo?
1. 7
2. 10
3. 30
4. 50

Question 3-40 is to be judged True or False.

3-40. All other factors being equal, a developed film having a high density will require less time to fix than a developed film with a low density.

3-41. All other factors being equal, which film, an exposed and developed or an undeveloped, requires the most time in a fixer to "clear"?
1. Exposed and developed
2. Undeveloped

3-42. Fixation of a film is complete when
1. twice the time required for the film to clear has elapsed
2. all the silver halides are dissolved
3. the film has been in the fixer for 5 minutes

3-43. A developed film clears after being in the fixer for 4 minutes. How many more minutes should the film be treated in the fixer?
1. 1
2. 2
3. 8
4. 4

3-44. A fresh fixer used in a B&W film process takes 4 minutes to fix or clear a sheet of undeveloped film. This same fixer takes 3 minutes to clear a developed sheet of film. The fixer should be considered exhausted when it takes how many minutes to clear undeveloped film?
1. 6
2. 7
3. 8
4. 14

The following information is to be used in answering questions 3-45 through 3-49.

3-45. For how many minutes should film be treated in the first fixer?
1. 12
2. 24
3. 3
4. 6

3-46. For how many minutes should the film be treated in the second fixer?
1. 12
2. 24
3. 3
4. 6

3-47. After several days, the first fixer takes 13 minutes to clear the film. Which of the following actions should you take?
1. Treat the film for 13 minutes in both fixing baths
2. Treat the film for 13 minutes in the first bath and for 6.5 minutes in the second
3. Treat the film in the first and second bath each for 6 minutes, after all, the purpose of the twin bath system is to maintain a constant fixing time
4. Replace the first fixer with the second and place new fixer in use as the second fixer

Questions 3-48 and 3-49 are to be judged True or False.

3-48. Silver should be reclaimed from the first fixing bath.

3-49. This method of fixing films is inconvenient, however, it is economical.

3-50. Which of the following statements regarding film processing is/are correct?
1. Development is the most important step
2. Fixing is the most important step
3. Washing is the most important step
4. All of the above

3-51. The purpose of film washing is to remove
1. black metallic silver
2. silver halides
3. developer
4. fixer

Assignment 4

Film Processing

Textbook: Pages 3-8 through 3-22

Learning Objective: Recognize the purpose of, procedures followed, and conditions indicated in washing and drying processed film.

4-1. A freshwater wash requires 20 minutes to remove hypo from the film. A total of how many minutes of wash time should be allowed when film is washed in seawater?
1. 5
2. 7
3. 15
4. 25

4-2. What is the approximate maximum wash water temperature in a sinkline process?
1. 60°F
2. 65°F
3. 70°F
4. 75°F

4-3. The time required to wash negatives is 20 minutes. Halfway through a wash cycle a visitor to the lab puts a hand, which is contaminated with hypo, into the wash tank. How much longer should you wash the negatives?
1. 10 minutes
2. 20 minutes
3. 30 minutes

4-4. If the sinkline tank in which films are being washed undergoes a complete change of water every 3 minutes, for how many minutes should (a) 6 films and (b) 12 films be washed?
1. (a) 10 (b) 20
2. (a) 20 (b) 20
3. (a) 10 (b) 40
4. (a) 20 (b) 30

4-5. What is the final step in film processing?
1. Fixing
2. Washing
3. Drying
4. Captioning

4-6. Why should excess water be removed from a negative before it is placed in a drying cabinet?
1. To prevent uneven drying
2. To hasten drying
3. To prevent dust from adhering to the emulsion

4-7. Which of the following statements is correct regarding wetting agents for film?
1. They promote even drying
2. They help wash the film because they are a soap-type substance
3. They retard vigorous drying which is a cause of film curl
4. They shrink swollen gelatin

4-8. When a long roll of 35mm film is placed in a dryer to dry, what should you do to prevent the film from curling?
1. Attach a film clip to the bottom of the roll
2. Cut the film into 6-frame segments
3. Dry the film on the film reel
4. Hang the film in a U-shape loop

4-9. What is the best "cure" for film drying problems?
1. Rewashing
2. Retouching
3. Using a wetting agent
4. Prevention

4-10. All other factors being equal, what type of negative will dry faster?
1. A dense negative
2. A thin negative

4-11. Why do film dryers employ air impingement?
1. It helps harden the gelatin
2. It causes the metallic silver to "set"
3. It prevents film curl
4. It promotes faster drying

4-12. Film which is overdried will curl toward the
1. emulsion
2. base

4-13. The purpose of duckboards in a photographic processing sink is to permit
1. rocking of the trays and/or tanks for even agitation
2. the water to drain completely
3. the tanks and/or trays to float in the water bath
4. water to circulate under and around tanks and trays to keep the chemicals warm

4-14. An air conditioned photo lab should be maintained at which of the following temperatures?
1. 68°F
2. 72°F
3. 78°F
4. 82°F

4-15. Which of the following factors has the greatest bearing on the selection of a safelight filter for use with a given film?
1. The power of the light bulb to be used
2. The distance from the safelight to the film being processed
3. The color sensitivity of the film being processed
4. The length of time the film will be exposed to the illumination of the safelight

4-16. It takes 18 minutes to process a given film. To carry out the entire process of this film under the illumination of a safelight, the safelight must NOT cause any evidence of fogging for what minimum length of time?
1. 18 minutes
2. 27 minutes
3. 36 minutes
4. 45 minutes

4-17. You find it necessary to process B&W panchromatic film under safelight illumination. What minimum amount of total developing time should elapse before you use the safelight?
1. One-fourth
2. One-third
3. One-half
4. Two-thirds

4-18. What type of rollfilm reel is generally used in Navy photo labs?
1. Thumb feed plastic
2. Center feed plastic
3. Thumb feed stainless steel
4. Center feed stainless steel

4-19. What is the maximum number of sheet films that should be washed at one time in a tray?
1. One
2. Two
3. Three
4. Four

4-20. The most effective method for washing film in a tray is to
1. allow the water to fall directly on the film
2. dump or change the water in the tray every 5 minutes
3. constantly rock the tray
4. use a siphon system

● Question 4-21 is to be judged True or False.

4-21. When several sheets of film are to be washed in a tank at one time, the films should be placed in film hangers.

4-22. Which device promotes the most efficient washing of rollfilm?
1. A rapid rollfilm washer
2. A rollfilm processing tank

In answering questions 4-23 through 4-27, select from column B the lighting condition under which the processing step used as the question in column A should be carried out.

	A. Steps		B. Conditions
4-23.	Fixing	1.	Dark
4-24.	Drying	2.	White light
4-25.	Washing		
4-26.	Developing		
4-27.	Stop		

4-28. Which of the following factors is NOT generally considered to control negative image density?
1. Developer temperature
2. Amount of agitation
3. Amount of development
4. Volume of developer

4-29. A given film is to be developed for a given time at a given temperature. What is the term used to describe this type of development?
1. Predetermined
2. Manufacturer recommended
3. Time and temperature
4. Given

4-30. If a film is processed with the time and temperature method and the developer temperature is too low, which of the following conditions may result?
1. Overdevelopment
2. Excessive contrast
3. Low density

● In answering questions 4-31 through 4-35, refer to the data sheet on page 3-18 of the text.

4-31. Which of the following developers is NOT recommended for use with the film to which the data sheet applies?
1. D-76
2. Polydol
3. HC-110
4. DK-20

4-32. If the film to which the data sheet applies is to be processed in a tank for 7.5 minutes, what should be the temperature of Microdol-X developer?
1. 65°F
2. 68°F
3. 70°F
4. 72°F

4-33. The film to which the data sheet applies should be treated in the stop bath for what maximum amount of time?
1. 5 seconds
2. 10 seconds
3. 15 seconds
4. 30 seconds

4-34. Using the chemicals and specifications listed in the data sheet for the film to which it applies, what is the maximum processing time beginning with development and ending with washing?
1. 21.5 minutes
2. 46.5 minutes
3. 50.5 minutes
4. 51.5 minutes

4-35. To what type of film does the data sheet probably apply?
1. Tri-X Pan
2. Plus-X Pan
3. Technical Pan
4. Royal-X Pan

4-36. Black and white film should normally be hand processed at what temperature?
1. 65°F
2. 68°F
3. 70°F
4. 72°F

● Question 4-37 is to be judged True or False.

4-37. When you are processing B&W film by hand, only the developer temperature needs to be controlled to a significant degree.

4-38. You have used an immersion heater to raise the temperature of the developer. However, the temperature is now too high. Which of the following actions should you take to reduce the developer temperature?
1. Add cold water to the developer at the rate of 1 ounce per gallon of developer and add one-fourth of a minute to the developing time for each ounce or portion of an ounce of water added
2. Add ice to the developer at the rate of one cube per 32 ounces of developer or portion thereof and increase development time by 5 seconds per ice cube
3. Allow the developer to sit and cool naturally

● Question 4-39 is to be judged True or False.

4-39. When film is processed with the time and temperature method, agitation is not of consequence.

4-40. When processing by inspection, the film should be examined by
1. transmitted light through the base side only
2. transmitted light through the base and emulsion sides
3. reflected light through the base side only
4. reflected light through the base and emulsion sides

4-41. What is the approximate number of line copy sheet films recommended for processing in a tray at one time?
1. One
2. Six
3. Three
4. Nine

4-42. What size tray should be used to process 8x10 sheet film?
1. 8x10
2. 11x14
3. 16x20
4. 20x24

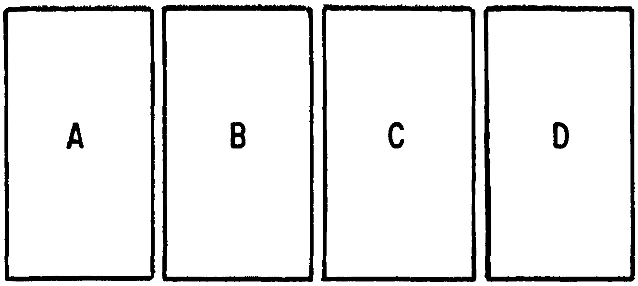


Figure 4A.--Film processing trays.

- In answering question 4-43, refer to figure 4A.

4-43. When you are processing one sheet of film at a time, in which tray should the developer be?
1. A
2. B
3. C
4. D

4-44. When you are developing sheet film in a tray, agitation should be
1. constant for the first minute and intermediate for 2 seconds every 1 minute thereafter
2. constant for the first 2 minutes and intermediate for 5 seconds every 30 seconds thereafter
3. constant
4. intermediate

4-45. The processing instructions for a given film specify developing at a given temperature for 6 minutes with intermittent agitation. When you use the same developer at the given temperature, approximately how long should the film be developed in a tray?
1. 1 minute and 45 seconds
2. 2 minutes and 45 seconds
3. 3 minutes and 45 seconds
4. 4 minutes and 45 seconds

- Question 4-46 is to be judged True or False.

4-46. When you process sheet film in a tray, constant agitation is necessary throughout the entire process.

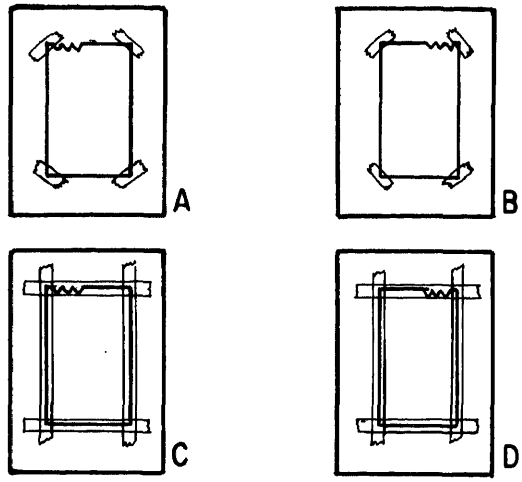


Figure 4B.--Film processing trays.

- In answering question 4-47, refer to figure 4B.

4-47. In which tray is the film properly positioned for processing?
1. A
2. B
3. C
4. D

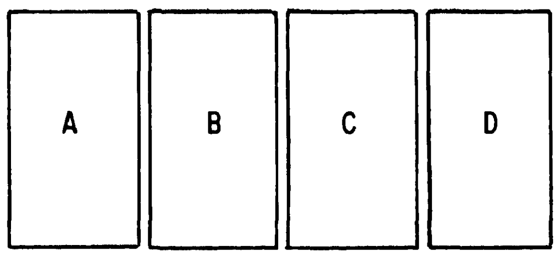


Figure 4C.--Film processing trays.

- In answering question 4-48, refer to figure 4C.

4-48. When more than one sheet of film will be processed at a time, in which tray should the predevelopment rinse be?
1. A
2. B
3. C
4. D

Assignment 5

Film Processing

Text: Pages 3-23 through 3-43

Learning Objective: Recognize the correct procedures for processing sheet and rollfilm by both tank and tray methods.

● Question 5-1 is to be judged True or False.

5-1. As when you develop one sheet of film at a time in a tray, agitation should also be constant when several sheets are processed at a time.

5-2. When several sheets of film are to be tray processed at a time, approximately how long should the films remain in the predevelopment rinse?
1. 1 minute
2. 5 minutes
3. 10 seconds
4. 30 minutes

● Questions 5-3 through 5-6 are to be judged True or False.

5-3. When several films are processed in a tray, the film should be placed into the developer emulsion side up.

5-4. When several films are processed in a tray, the timer is started just before the first film is placed in the tray.

5-5. When several films are being tray processed at one time, agitation should be accomplished by tray rocking.

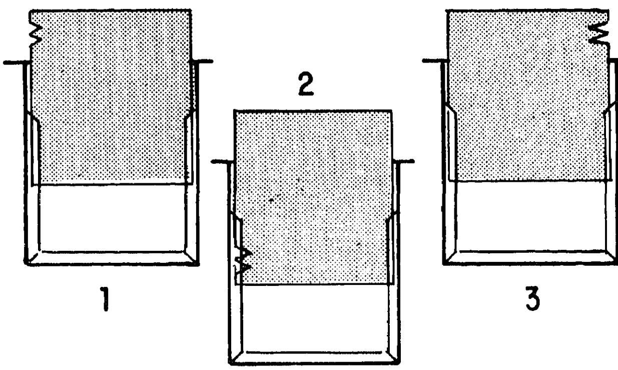
5-6. When several films are processed in trays at one time and once development has been stopped, the films may all be placed into the fixer at one time.

5-7. Of the tray and tank methods of processing panchromatic sheet film, which is preferred?
1. Tank
2. Tray

5-8. At least how many tanks should be used to process sheet film?
1. One
2. Two
3. Three
4. Four

5-9. Where in relation to the stop bath should a tank of developer be located?
1. To the left of the stop bath
2. To the right of the stop bath

5-10. Which film hanger is being properly loaded?



5-11. When sheet films are processed with hangers and tanks, which of the following is/are (an) advantage(s) of using the predevelopment rinse?
1. Air bubbles can be reduced in the developer
2. More uniform development occurs
3. The film and hanger temperature can be stabilized to the developer temperature
4. All of the above

-12. A predevelopment rinse for films in sheet film hangers should be approximately about how many minutes?
1. 1 minute
2. 2 minutes
3. 3 minutes
4. 4 minutes

● Question 5-13 is to be judged True or False.

-13. Once air bubbles have been dislodged from sheet films in tank processing, agitation should begin immediately.

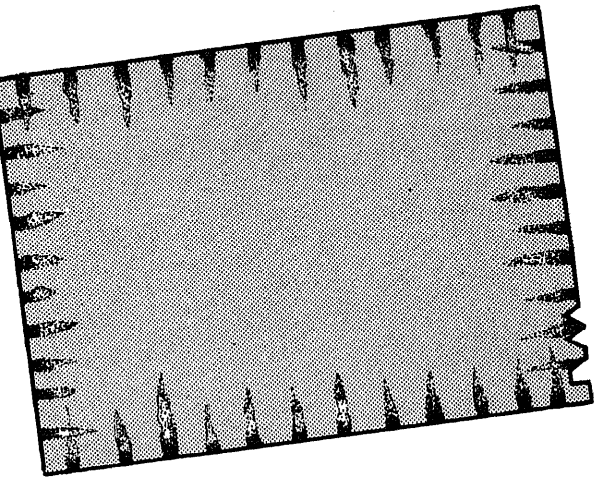


Figure 5A

● In answering question 5-14, refer to figure 5A. The film was processed in a film hanger and tank.

5-14. Which of the following factors probably contributed to the developing trails?
1. Lack of predevelopment rinse
2. Use of predevelopment rinse
3. Inadequate agitation
4. Excessive agitation

5-15. When films being processed in hangers and tanks are removed from the developer, (a) for how many seconds should they drain and (b) is this drain time considered as part of the developing time?
1. (a) 5 (b) yes
2. (a) 5 (b) no
3. (a) 10 (b) yes
4. (a) 10 (b) no

5-16. You should constantly agitate sheet film in hangers in the fixer for how many minutes?

● Question 5-17 is to be judged True or False.

5-17. The "washing" that film hangers receive during film washing precludes any need for additional washing.

5-18. What processing method is best for hand processing rollfilm?
1. Tray
2. Deep tank
3. Rollfilm tank

● Questions 5-19 and 5-20 are to be judged True or False.

5-19. Once reels of black and white negative-type film have been placed in a rollfilm tank and the tank cover is in place, the rest of the process can be carried out in white light.

5-20. When you load a center feed film processing reel, the film emulsion should face in.

5-21. When you hold a center feed film processing reel in your right hand for loading, the ends of the spiral wires should be in (a) what position, and (b) facing in what direction?
1. (a) Top (b) right
2. (a) Bottom (b) left
3. (a) Top (b) left
4. (a) Bottom (b) right

● Question 5-22 is to be judged True or False.

5-22. A center feed spiral reel is to be loaded with 35mm film. The first exposure of the film is to be at the center of the reel. It is necessary to cut the tongue of the film prior to loading the reel.

5-23. You want to process three rolls of 35mm film in a rollfilm tank capable of holding six film reels. Which of the following statements is correct regarding this situation?
1. It can't be done
2. Only enough solution to cover three reels should be used
3. An empty reel should be placed in the bottom of the tank followed by one loaded reel, then another empty reel, then a loaded reel, etc.
4. Three empty reels should be placed on top of the loaded reels and the tank should be filled with solution

5-24. Your rollfilm processing tanks have provision for changing solutions in white light. What minimum number of tanks is required to process six rolls of 35mm film?
1. One
2. Two
3. Three
4. Six

5-25. Why should you NOT use water from the water bath in a processing sink for the predevelopment rinse?
1. It may not be at the correct temperature
2. It would lower the water level in the sink thus affecting the processing chemical temperatures
3. It may contain a foreign substance

5-26. How should air bubbles be dislodged from rollfilm being processed with the tank and reel system?
1. Roll the tank along the bottom of the sink
2. Invert the tank several times
3. Shake the tank
4. Bang the tank on the edge of a hard surface

5-27. When you are processing rollfilm with tanks and reels, what is the approximate minimum predevelopment rinse time?
1. 15 seconds
2. 30 seconds
3. 60 seconds
4. 120 seconds

5-28. When the solution is added through the tank cover, about how many seconds should it take to fill a large rollfilm tank with developer?
1. 5
2. 10
3. 15
4. 20

Question 5-29 is to be judged True or False.

5-29. When film is processed in a rollfilm tank, you should hold the tank in your hand to keep the solution temperature up.

5-30. To dump the solution from a rollfilm tank with the cover in place should take (a) how many seconds, and (b) should this drain time be considered part of the process time?
1. (a) 5 (b) yes
2. (a) 5 (b) no
3. (a) 10 (b) yes
4. (a) 10 (b) no

5-31. When stop bath is added to a rollfilm tank, the film should be intently agitated for about how many seconds?
1. 5
2. 2
3. 10
4. 15

5-32. During which step in a B&W film process may the lighttight rollfilm cover first be removed?
1. Developer
2. Stop
3. Fix
4. Wash

5-33. When you are washing film in a rapid rollfilm washer, (a) how long should the film be washed and (b) should the reels be allowed to turn throughout the entire wash cycle?
1. (a) 20.0 minutes (b) yes
2. (a) 10.0 minutes (b) yes
3. (a) 5.0 minutes (b) no
4. (a) 2.5 minutes (b) no

5-34. In a rollfilm tank, the film should be treated in wetting agent for about how many seconds?
1. 15
2. 30
3. 60
4. 120

5-35. As a general rule, a "normal" B&W negative should make a good print when printed with what variable contrast printing filter?
1. No. 1
2. No. 2
3. No. 3
4. No. 4

5-36. "The differences between highlight density and shadow density" is a definition of what B&W negative characteristic?
1. Opacity
2. Tonal gradation
3. Contrast
4. Graininess

5-37. The range of grays between the greatest and the least density in a B&W negative is referred to as
1. opacity
2. contrast
3. tonal gradation
4. density

5-38. In a negative, "graininess" is used to describe the
1. coarseness of the individual silver grains
2. size of individual silver grains
3. clumping of silver grains
4. density of a mass of silver grains

• Question 5-39 is to be judged True or False.

5-39. A "heavy" negative has a high density.

5-40. Which of the following combined factors would most probably result in a thin negative?
1. Overexposure and overdevelopment
2. Overexposure and underdevelopment
3. Underexposure and overdevelopment
4. Underexposure and underdevelopment

5-41. Which of the following areas in a photographed scene will produce the highlights in a B&W negative?
1. Shadows
2. A red car
3. A black sailor
4. A white road sign

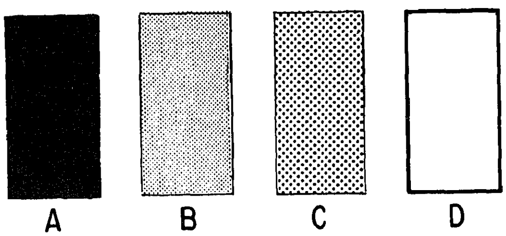


Figure 5B.--Negative area density.

• In answering questions 5-42 through 5-49, refer to figure 5B.

5-42. Which area best represents a highlight?
1. A
2. B
3. C
4. D

5-43. Which area best represents an underexposed shadow?
1. A
2. B
3. C
4. D

5-44. Which areas best represent tonal gradation?
1. A and C
2. B and C
3. B and D
4. C and D

5-45. What area best represents underexposure?
1. A
2. B
3. C
4. D

5-46. What area best represents overdevelopment?
1. A
2. B
3. C
4. D

5-47. Which areas best represent negative contrast?
1. A and B
2. B and C
3. C and D
4. D and A

5-48. Which areas best represent the halftones?
1. A and B
2. B and C
3. C and D
4. D and A

5-49. If the negative contained areas A and D only, it would have which of the following negative contrast characteristics?
1. Low
2. Normal
3. High

5-50. What is the usual cause of a low contrast B&W negative?
1. Overexposure
2. Overdevelopment
3. Underexposure
4. Underdevelopment

5-51. Which of the following factors may contribute to negative graininess?
1. The type of emulsion
2. Development
3. Exposure
4. Each of the above

5-52. A processed negative has several very small round transparent spots about the size of a pinhead. What was the probable cause of this negative defect?
1. Air bubbles on the film during development
2. Blisters in the emulsion
3. Oxidized developer
4. A strong acid stop bath

• Question 5-53 is to be judged True or False

5-53. When B&W film is processed to a positive image, a negative image is not formed.

5-54. The top emulsion layer of a color film is sensitive to what color of light?
1. Red
2. Green
3. Blue
4. Yellow

5-55. What color is the image in the top emulsion layer of a processed color negative?

1. Red
2. Green
3. Blue
4. Yellow

Assignment 6

Black and White Printing

Textbook: Pages 4-1 through 4-16 and 4-21

Learning Objective: Recognize factors affecting the production and quality of contact and projection black and white prints.

6-1. The most familiar type of photographic print has what kind of base?
1. Paper
2. Film
3. Resin
4. Ester

6-2. What are the most often used methods of making photographic prints?
1. Positive and negative reproduction
2. Contact and projection printing
3. Precision and fallacious reduction

6-3. What printing method(s) can be used to produce print images which are the same size as the negative images?
1. Precision
2. Contact
3. Projection
4. Both 2 and 3 above

6-4. To what color of light are photographic papers primarily sensitive?
1. Red
2. Green
3. Blue

6-5. When hand processing B&W prints, you should use what minimum number of trays?
1. One
2. Two
3. Three
4. Four

6-6. How many trays should be used to hand process B&W prints?
1. One
2. Five
3. Three
4. Seven

6-7. When a developer is mixed using one part water and two parts developer, how is the ratio of chemical to water written?
1. 1:1
2. 1:2
3. 2:2
4. 2:1

6-8. Which of the following times could be considered about average for hand development of photographic paper at 68°F?
1. 105 seconds
2. 210 seconds
3. 30 seconds
4. 60 seconds

6-9. About how many 4x5-inch prints could you expect to process in 64 ounces of D-72?
1. 100
2. 200
3. 300
4. 400

6-10. Which of the following statements regarding contact printing is/are correct?
1. The exposing light is directed up through the negative
2. The exposing light is directed down through the negative
3. The negative and paper should be in contact
4. All of the above

6-11. Contact printing produces a negative to print image size ratio of
1. 1:1
2. 1:2
3. 2:1
4. 2:2

6-12. In Navy photo labs, what is the most common method of making prints?
1. Enlarging
2. Contacting

6-13. What grade of glass should be used on a contact printer used to make color prints?
1. White
2. Neutral
3. Crystal
4. Clear A1

6-14. When you use a proof printer to make contact prints, in relation to the pad material, where and how should the paper be placed?
1. Emulsion up on the pad
2. Emulsion down on the pad
3. Emulsion up with the negative between the pad and paper
4. Emulsion down with the negative between the pad and paper

6-15. What is the main purpose of a masking device on a contact printer?
1. It protects the glass from scratches
2. It allows the prints to be produced with white borders
3. It holds the paper in place
4. It separates the negative from the glass

6-16. Which of the following statements regarding film and paper is generally correct?
1. Both film and paper have a shiny base
2. The emulsion side of a negative is shiny while the base side of paper is shiny
3. Both film and paper have a dull base
4. The emulsion side of a negative is dull while the emulsion side of a paper is shiny

6-17. Photographic papers generally have a tendency to curl toward which side?
1. Emulsion
2. Base

6-18. A sheet of 8x10-inch film was loaded into a film holder with its emulsion in. Camera exposure, therefore, was through the base. Assuming a negative with adequate density was produced, how should this negative be contact printed?
1. It should be printed with its emulsion in contact with the paper's emulsion
2. It should be printed with its base in contact with the paper's emulsion
3. It should be printed with its emulsion in contact with the paper's base

● Question 6-19 is to be judged True or False.

6-19. Proof prints should always have white borders.

6-20. What is the term used to describe the guide on a contact printer which facilitates quick and proper paper alignment?
1. Mask
2. Goldenrod
3. Paper stop
4. Print border mark

● Question 6-21 is to be judged True or False.

6-21. To prevent any possibility of the negative slipping during the production of a large number of contact prints, the negative should be taped along all four sides to the printer glass.

6-22. What type of printing paper is generally used to make contact prints in Navy photo labs?
1. Contact grades 1 through 4
2. Enlarging grades 1 through 4
3. Variable contrast contact
4. Variable contrast enlarging

6-23. A contact print was made with a number 3 variable contrast printing filter. The resulting print lacked adequate contrast. Which of the following number filters should be used to make the reprint?
1. No. 1
2. No. 2
3. No. 1 1/2
4. No. 4

6-24. Contact print exposure is NOT dependent upon which of the following factors?
1. Intensity of the printing light
2. Sensitivity of the paper
3. Size of the printing glass
4. Amount of black metallic silver in the negative

● Questions 6-25 and 6-26 are to be judged True or False.

6-25. Your first contact test print is too dark, therefore you should decrease the exposure time.

6-26. An experienced darkroom worker can easily judge the correctness of contrast in an overexposed print.

6-27. When the developing and exposure factors are correct, about how long should it take for a developing print image to appear?
1. 5 seconds
2. 2 seconds
3. 30 seconds
4. 15 seconds

6-28. In hand processing prints, the term "pull" refers to what action(s)?
1. Pulling the print through the entire process
2. Removing the print from the developer
3. Giving the print less than adequate development
4. Both 2 and 3 above

6-29. A test print made with a number 2 printing filter has dingy gray highlights. The next test print should be made with which of the following printing filters?
1. No. 1
2. No. 2
3. No. 3
4. No. 0

6-30. A negative with normal contrast was printed with a number 4 printing filter. Which of the following statements best describes how the print will probably appear?
1. The number of tones reproduced will closely match the original scene tones
2. The print will show an abundance of middle tones with few shadow areas
3. The print will be very flat
4. The print will have high contrast

● Question 6-31 is to be judged True or False.

6-31. A print being processed by hand should initially be placed into the developer emulsion up.

6-32. How should prints being developed in a tray be agitated?
1. Frequently
2. Intermittently
3. Gently
4. Constantly

6-33. Regarding print quality, which of the following statements is most accurate?
1. Print quality depends heavily upon correct exposure only
2. Print quality depends heavily upon correct development only
3. Print quality depends heavily upon correct exposure and development
4. Print quality is primarily governed by the working characteristics of the paper and developer

6-34. When you are processing one print at a time, for about how many seconds should each print be treated in a tray of stop bath?
1. 10
2. 20
3. 5
4. 15

6-35. What is the probable result of a fixing bath which has a higher than normal specific gravity?
1. Prints will sink to the bottom
2. Prints will float
3. Prints will blister
4. The print emulsion will separate from the base

● Question 6-36 is to be judged True or False.

6-36. If prints are placed emulsion up in a fixing bath they could become stained where they come into contact with air, however, if they are placed facedown in the fixer there is no chance of them being stained.

6-37. Which of the following results is NOT an advantage of using the twin fixing bath method for fixing prints?
1. Less chemicals are used
2. Better fixation occurs
3. More prints can be fixed in a given time
4. More equipment is required

6-38. When you are fixing prints with the twin fix method, what is about the maximum time in minutes that prints should be fixed?
1. 6
2. 10
3. 3
4. 5

6-39. When you use the twin bath fix technique, when should the "first" fixer be discarded?
1. After two hundred 8x10-inch prints have been fixed
2. After it has been reused as the second fixer for an additional two hundred 8x10-inch prints
3. After the silver has been reclaimed

6-40. Your lab uses the twin fixing technique in its custom B&W print room. Each tray holds 20 gallons of fixer. How many 8x10-inch prints can be fixed in the second tray of fixer before it is shifted to the first tray position?
1. 1000
2. 2000
3. 8000
4. 4000

• When you are developing 26 8x10-inch prints at one time in a tray, how is agitation accomplished?
1. The bottom print is moved to the top of the stack
2. The top print is moved to the bottom of the stack
3. All the prints are turned at one time and quickly fanned
4. Each print, in succession, is removed from the developer, drained 5 seconds then placed at the bottom of the stack

2. When a large number of prints are being tray processed at one time, for about how many seconds should they be treated in the stop bath?
1. 15
2. 60
3. 30
4. 90

3. "Dodging" and "burning in" are terms which best describe which of the following controls?
1. Contrast
2. Process
3. Exposure
4. Sensitivity

4. A "straight" print refers to a print which has been printed without
1. a developer mixed 1:2
2. a glass plate between the negative and light source
3. contrast
4. the aid of exposure control tools

5. Preventing exposure of a selected area of a print is called
1. dodging
2. burning in

6. When the overall exposure for a print was 7 seconds and the exposure for a selected area of the same print was increased to 12 seconds, what printing technique was used?
1. Dodging
2. Printing in

7. When you are making contact prints with a contact printer, (a) in what position relative to the negative should dodging tissue be placed, and (b) about how far from the negative should the tissue be placed?
1. (a) Above (b) 2 inches
2. (a) Above (b) 1/2 inch
3. (a) Below (b) 2 inches
4. (a) Below (b) 1/2 inch

6-48. The term "dodging" is synonymous with which of the following terms?
1. Printing in
2. Burning in
3. Shading
4. Laying on

Questions 6-49 and 6-50 are to be judged True or False.

6-49. For the sake of economy only a minimum amount of developer should be used at any one time to process large quantities of prints.

6-50. The term "enlarging", as a rule, refers to projection printing only when the negative image is being made bigger on the print.

6-51. For which of the following reasons would you employ the techniques of dodging and burning in?
1. To increase print image detail
2. To decrease print image detail
3. To increase print image size
4. To decrease print image size

6-52. What method of printing permits image distortion correction control?
1. Projection
2. Contact

6-53. What method of printing permits the introduction of image distortion?
1. Enlarging
2. Contact

6-54. A 4x5-inch negative was printed so that the entire negative image was reproduced on an 8x10 print. What is the image magnification on the print?
1. 1X
2. 2X
3. 3X
4. 4X

6-55. A sheet of 8x10-inch paper can be cut into four 4x5-inch pieces and used to make four 4x5-inch prints of the full image of a 4x5-inch negative. If instead, the full image of the negative were enlarged to 8x10 inches, the negative image would be enlarged how many times?
1. One
2. Two
3. Three
4. Four

6-56. A selected area of a negative which measures 1.75 inches is enlarged so that the corresponding print image measures 8.75 inches. To what magnification was the image printed?
1. 3
2. 2
3. 5
4. 6

6-57. A glass sandwich-type negative carrier would be most appropriate for printing which of the following size negatives?
1. 35mm
2. 2 1/4
3. 4x5
4. 8x10

6-58. For printing 8x10-inch negatives, a lens with which of the following focals lengths should be considered normal?
1. 4.0 inches
2. 6.5 inches
3. 10.0 inches
4. 12.5 inches

6-59. In order to make a print image the same size as the negative image when using an enlarger equipped with a 150mm lens, the enlarger must have a bellows extension capability of at least how many millimeters?
1. 150
2. 600
3. 300
4. 450

6-60. You need to make prints with the image size smaller than the negative image size. The enlarger you will use is equipped with a 75mm lens. Which of the following bellows extensions is the minimum required?
1. 75mm
2. 150mm
3. 300mm
4. 600mm

Assignment 7

Black and White Printing

Textbook: Pages 4-16 through 4-45

Learning Objective: Identify the construction features and operating characteristics of projection printers.

7-1. All other factors being equal, which enlarger will produce the greatest print contrast?
1. Diffusion
2. Condenser

7-2. Which type of projection printer should you use to obscure negative defects when the print is made?
1. Diffusion
2. Condenser

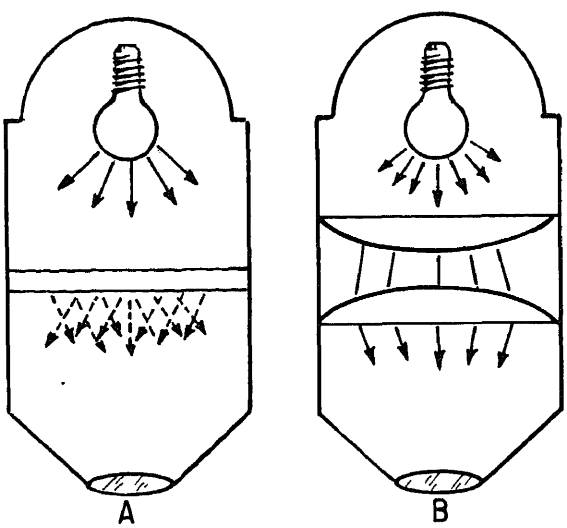


Figure 7A.--Enlargers

In answering questions 7-3 through 7-7, refer to figure 7A.

7-3. Which is the diffusion enlarger?
1. A

7-4. All other factors being equal, which enlarger will produce the softer image?
1. A
2. B

7-5. Which enlarger should be used to achieve maximum print image tone separation?
1. A
2. B

7-6. When very large prints are to be made which enlarger is most appropriate?
1. A
2. B

7-7. Which enlarger should be used to print a retouched portrait negative?
1. A
2. B

Question 7-8 is to be judged True or False.

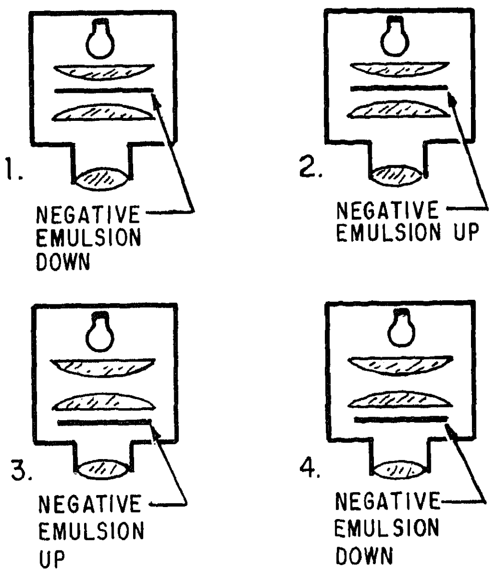
7-8. Any high quality camera lens can be used on an enlarger to produce high-quality prints.

7-9. All other factors being equal, which of the following enlarger lens focal lengths and lens-to-paper combinations will provide the greatest image magnification?
1. 150mm at 6 in.
2. 105mm at 6 in.
3. 75mm at 6 in.
4. 50mm at 6 in.

7-10. All other factors being equal, which of the following enlarger lens focal lengths and lens-to-paper combinations will provide the greatest image magnification?
1. 400mm at 48 in.
2. 200mm at 36 in.
3. 100mm at 12 in.
4. 50mm at 6 in.

7-11. It would most likely be necessary to consider depth of field when you are making enlargements under which of the following circumstances?
1. When dodging is employed
2. When variable contrast paper is used
3. When printing a 35mm negative of a tall building
4. When the negative image shows a very shallow depth of field

7-12. In which enlarger is the negative properly positioned?



7-13. For which of the following reasons is a "focusing" sheet placed on the easel when you are composing a projected negative image?
1. To make the image easier to see in the dark
2. To keep the easel base clean
3. To permit accurate focusing

● Assume a negative shows very shallow depth of field and the enlarger is equipped with a lens having the f/stops used as the alternatives for questions 7-14 through 7-17.

7-14. If the image is to be enlarged, at which f/stop should the projected image be focused?
1. f/22
2. f/16
3. f/8
4. f/5.6

7-15. If the negative image size and print image size are to be the same, at which f/stop should the projected image be focused?
1. f/16
2. f/11
3. f/8
4. f/5.6

7-16. If the print image size is to be smaller than the negative image size, at which f/stop should the projected image be focused?
1. f/16
2. f/11
3. f/8
4. f/5.6

7-17. If the negative image and print image size are to be the same, at which f/stop should the projected image be focused?
1. f/16
2. f/11
3. f/8
4. f/5.6

Learning Objective: Identify printing and processing procedures applicable to projection printing including adjustments, exposure, and processing.

7-18. About how many seconds of exposure time is considered good for making B&W projection prints?
1. 10
2. 2
3. 30
4. 60

7-19. Which of the following factors does NOT affect the exposure time for both contact and enlargement prints?
1. The light source
2. Negative density
3. The degree of image magnification
4. The speed of the paper

7-20. The most reliable method of determining enlargement exposure requirements is to use
1. your knowledge of paper speed
2. test strips
3. enlarging exposure meters
4. a standard negative of known density and contrast

Questions 7-21 and 7-22 are to be judged True or False.

7-21. Because enlargement test prints are made with several exposures they need not be fully developed before they are evaluated.

7-22. Increasing the developing time for film increases the contrast in a B&W negative, whereas with photographic printing paper, an increase in developing time will always decrease the print image contrast.

7-23. You have made a test print which has a 5-second exposure segment which is too light and a 10-second exposure segment which is too dark. Which of the following procedures should you follow?
1. Make the production prints at 7.5 seconds of exposure
2. Change the f/stop from f/11 to f/8
3. Make another test print
4. Change the magnification to .05X

7-24. When you are using variable contrast paper to print a B&W negative which has very low contrast what color should the exposing light be to produce a print with normal contrast?
1. Cyan
2. Green
3. Deep violet
4. Yellow

7-25. When printing a very contrasty negative on selective contrast printing paper and a print of normal contrast is desired, what portion of the paper emulsion should you expose?
1. The green-light-sensitive portion
2. The yellow-light-sensitive portion
3. The magenta-light-sensitive portion
4. The violet-light-sensitive portion

7-26. The highlights in a test print made on selective contrast paper have correct density, however, the shadow density is low. The print probably has a contrast which is too
1. low
2. high
3. dark
4. light

7-27. The highlights in a test print made on selective contrast paper with a 3 1/2 filter have correct density, however, the shadow densities are too low. The print probably has (a) what type of contrast and should be reprinted with (b) what filter?
1. (a) High (b) No. 4
2. (a) High (b) No. 3
3. (a) Low (b) No. 4
4. (a) Low (b) No. 3

In answering questions 7-28 through 7-32, select from column B the Polycontrast filter most suitable for making a normal contrast print on variable contrast paper from the negative described in column A.

A. Negatives	B. Polycontrast Filters
7-28. High contrast	1. No. 1
7-29. Normal contrast	2. No. 2
7-30. Somewhat contrasty	3. No. 3
7-31. Somewhat low contrast	4. No. 4
7-32. Flat	

7-33. Which of the following Polycontrast filters would be most appropriate for making a low contrast print from a normal contrast negative?
1. No. 1
2. No. 2
3. No. 3
4. No. 4

(A) FILTER NO.1

(B) FILTER NO. 2

(C) FILTER NO. 3

(D) FILTER NO. 4

Figure 7B

In answering questions 7-34 through 7-38, refer to figure 7B and assume that each picture has normal contrast and was printed on variable contrast paper with the filter indicated and that the negatives from which the prints were made were each of different contrast.

7-34. Which picture was printed from the negative with high contrast?
1. A
2. B
3. C
4. D

7-35. Which picture was printed from the negative of normal contrast?
1. A
2. B
3. C
4. D

7-36. Which picture was printed from the negative of low contrast?
1. A
2. B
3. C
4. D

7-37. Which picture was printed from the negative with contrast slightly lower than normal?
1. A
2. B
3. C
4. D

7-38. Assume a number 4 Polycontrast filter was not available for printing picture D. Which of the following filter and/or filter exposure combinations would be most appropriate for making the print?
1. Number 1 and 3 filters
2. Two number 2 filters
3. A number 3-1/2 filter
4. A number 3 filter with one-fourth more exposure time than would be required if a number 4 filter were used

● Question 7-39 is to be judged True or False.

7-39. Only one variable contrast filter can be used for making a given print.

7-40. What is about the shortest reasonable exposure time for making projection prints?
1. 5 seconds
2. 2 seconds
3. 10 seconds
4. 15 seconds

7-41. Which of the following projection printing controls applies best to photographic composition?
1. Dodging
2. Cropping
3. Defusing
4. Burning in

7-42. With regard to photographic composition when you are printing, which of the following statements is correct?
1. The only way to improve composition is to crop the print by adjusting the masking device on the easel
2. Changing image magnification is the only feasible way to change the composition
3. Enlarging the image and changing the border sizes will affect composition
4. Composition cannot be changed in printing because composition is established with camera exposure as it should be

7-43. In your test print, the main subject gives a physical impression to the viewer that it is about to slip out the bottom of the picture. In which of the following ways can you improve the reprint?
1. Dodge the foreground image area
2. Burn in the foreground image area
3. Place the main subject exactly on the bottom border of the print
4. Give the print black borders

● Questions 7-44 and 7-45 are to be judged True or False.

7-44. Photographic print borders should always be the same width on all sides of the print.

7-45. All official Navy photography should be printed with white borders.

7-46. In photographic printing, what technique is used to manipulate the light transmitted through (a) the dense area of a negative, and (b) the thin area of a negative?
1. (a) Dodging (b) printing-in
2. (a) Dodging (b) holding back
3. (a) Printing-in (b) dodging
4. (a) Printing-in (b) burning-in

7-47. When dodging a projection print image, why should you keep the dodging tool in constant motion?
1. To prevent image blur
2. So light from the enlarger will reflect off the tool so you can see it in the dark
3. To eliminate the possibility of the tool outline showing in the print
4. To prevent image reflection distortion

7-48. Which of the following printing techniques would be most appropriate to subdue facial blemishes reproduced in a negative?
1. Dodging
2. Printing in
3. Defusing
4. Vignetting

7-49. Pantyhose come in many colors. Which of the following colors makes the best defusing filter?
1. Flesh
2. Aqua
3. Desert sand
4. Gray

7-50. You are printing a very contrasty negative and a number 1 filter is inadequate for reducing the contrast. Which of the following printing techniques should you use to help reduce the print contrast?
1. Defusing
2. Vignetting
3. Dodging
4. Printing-in

7-51. The total exposure time for a given print is 12 seconds. How long should the exposure through a defusing screen last?
1. 6 seconds
2. 2 seconds
3. 12 seconds
4. 4 seconds

. A negative you are enlarging has objectional grain structure. Which of the following techniques should you use to subdue the grain structure to the greatest extent in the print?

1. A defusion enlarger with a smooth surface paper
2. A condenser enlarger with a rough surface paper
3. A condenser enlarger with a defusion filter and any surface paper
4. A defusion enlarger with a defusion filter and rough surface paper

. A grain focuser works best when the image area examined is

1. dense and in the center of the projected image area
2. light and in the center of the projected image area
3. dense and at the outside edge of the projected image area
4. light and at the outside edge of the projected image area

With which of the following steps of print processing does print finishing start?

1. Fixing
2. Washing
3. Drying
4. Captioning

All other factors being equal, which print will require the longest wash time?

1. Nonresin-coated
2. Resin-coated

What is about the average wash time in minutes for nonresin (a) double-weight papers, and (b) single-weight papers?

1. (a) 30 (b) 60
2. (a) 60 (b) 60
3. (a) 30 (b) 30
4. (a) 60 (b) 30

Which of the following wash water temperature ranges is recommended for washing RC prints?

1. 60°F to 70°F
2. 64°F to 76°F
3. 66°F to 74°F
4. 68°F to 78°F

7-58. Which of the following faults may cause RC paper to curl when dried?

1. Overexposure
2. Underdevelopment
3. Slow drying
4. Excessive washing

7-59. An RC print which would otherwise require a 4-minute wash has been treated in the fixer for an excessive length of time. How long should the print be washed?

1. 1 minute
2. 2 minutes
3. 5 minutes
4. 4 minutes

7-60. What is the maximum air temperature for drying resin-coated prints?

1. 150°F
2. 190°F
3. 220°F
4. 260°F

7-61. Which of the following instructions should you consult for instructions on disposing of prints classified Secret?

1. OPNAVINST 5510.1
2. OPNAVINST 5290.1
3. NAVAIR 3150.6
4. NAVAIR 10700.1

7-62. For information regarding the requirements of identification information for the back of photographic prints, which of the following references should you consult?

1. CHINFOINST 2790.3
2. OPNAVINST 5510.1
3. OPNAVINST 5290.1
4. Both 2 and 3 above

● Question 7-63 is to be judged True or False.

7-63. All photographic prints should be "pre-dried" before dry mounting.

7-64. Which of the following warnings should be placed on a hot dry mounting press?

1. WARNING
2. CAUTION
3. HOT
4. DANGER

Assignment 8

Color Printing

Textbook: Pages 5-1 through 5-14

Learning Objective: Apply the knowledge and understanding of the principles and techniques of color printing in analyzing and making adjustments to the color quality of color prints and producing high quality, color corrected prints.

8-1. Which of the following aspects of photography is considered the base on which to build your skill as a color printer?
1. Film exposure
2. Film processing
3. Black and white printing
4. Color printing

8-2. The color balance in a color print is controlled by the color quality of the
1. exposing light
2. negative emulsion
3. paper emulsion
4. filters used

8-3. What causes an object to appear a certain color?
1. Its actual color
2. Its perceived color
3. Its tone characteristics
4. Its reflection characteristics

- Question 8-4 is to be judged True or False.

8-4. White light has no color.

8-5. When blue is removed from white light, what is the resulting color?
1. Yellow
2. Green
3. Red
4. Magenta

8-6. The light primaries are (a) what three colors and (b) what three basic colors are needed to produce white light?
1. (a) Red, green, and blue
   (b) cyan, magenta, and yellow
2. (a) Red, green, and blue
   (b) red, green, and blue
3. (a) Cyan, magenta, and yellow
   (b) red, green, and blue
4. (a) Cyan, magenta, and yellow
   (b) cyan, magenta, and yellow

- In answering questions 8-7 through 8-10, assume you are overlapping beams of colored light. You are to select the color which is the result of mixing the colors used in the question.

8-7. Red and green.
1. Magenta
2. Blue
3. Yellow
4. Cyan

8-8. Red, green, and blue.
1. Magenta
2. Blue
3. Gray
4. White

8-9. Green and blue.
1. Cyan
2. Yellow
3. Red
4. Magenta

8-10. Blue and red.
1. Cyan
2. Magenta
3. Yellow
4. Green

8-11. What color is light which is greenish blue?
1. Yellow
2. Magenta
3. Cyan

8-12. What colors are considered the light secondaries?
1. White and gray only
2. White, gray, and brown
3. Red, green, and blue
4. Magenta, yellow, and cyan

8-13. What is the result of mixing the two light primaries blue and red?
1. The light primary magenta
2. The light secondary magenta
3. The light primary green
4. The light secondary green

8-14. What are the colors of the additive primaries?
1. Red, green, and blue
2. Cyan, magenta, and yellow
3. Red, green, and yellow
4. White, gray, and black

8-15. Color paper is sensitive to which of the following colors of light?
1. Red
2. Cyan
3. Yellow
4. All of the above

8-16. The middle emulsion layer of a color paper is sensitive to what color of light?
1. Yellow
2. Cyan
3. Green
4. Each of the above

8-17. When processed, what color is the dye in the middle emulsion layer of a color paper?
1. Yellow
2. Cyan
3. Magenta
4. Each of the above

8-18. What are the colors of the subtractive primaries?
1. Red, green, and blue
2. Cyan, magenta, and yellow
3. White, gray, and black

In answering questions 8-19 through 8-21, select from column B the color which is the result of mixing the colors listed as the question in column A.

	A. Mixtures	B. Colors
8-19.	Magenta and yellow	1. Green
8-20.	Cyan and yellow	2. Blue
8-21.	Magenta and cyan	3. Red

8-22. The colorant primaries in a color photograph are what colors?
1. Magenta, yellow, and cyan
2. Magenta, green, and blue
3. Blue, red, and green
4. Blue, yellow, and cyan

8-23. What are the subtractive primary colors?
1. Cyan, yellow, and magenta
2. Blue, green, and magenta
3. Green, red, and blue
4. Cyan, yellow, and blue

In answering questions 8-24 through 8-27, select from column B the color(s) of light which is/are absorbed by an object which appears to have the color listed in column A.

	A. Colors	B. Colors of Light
8-24.	Green	1. Red
8-25.	Magenta	2. Green
8-26.	Cyan	3. Green and blue
8-27.	Red	4. Red and blue

8-28. Upon which principle is today's color photographic process built?
1. Additive
2. Subtractive

8-29. What two colors of light, when mixed, will produce cyan?
1. Yellow + cyan
2. Green + red
3. Blue + green
4. Red + green

8-30. What color is complementary to (a) red, (b) green, and (c) yellow?
1. (a) Magenta (b) cyan (c) red
2. (a) Yellow (b) green (c) red
3. (a) Cyan (b) blue (c) yellow
4. (a) Cyan (b) magenta (c) blue

8-31. Which of the following types of filters is used in color printing to alter the spectral quality of the exposing light?
1. Skylight
2. Neutral density
3. Color compensating
4. Color correction

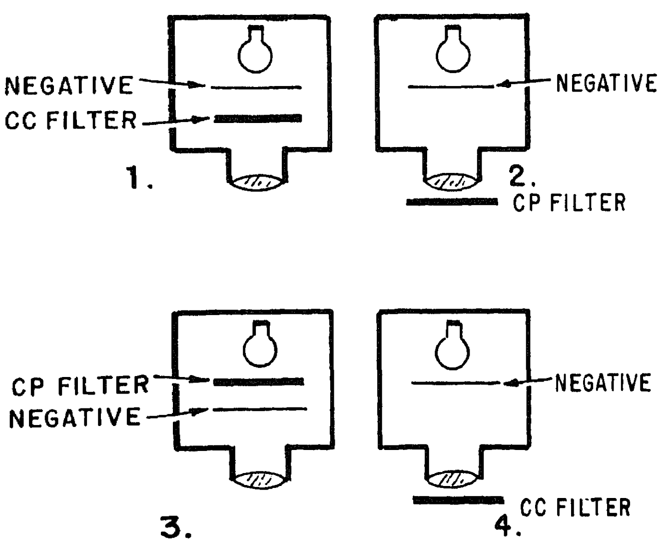
8-32. When making color prints, for which of the following reasons should you use color printing filters?
1. To alter the color of the negative image
2. To alter the color of light before it is emitted by the light source
3. To remove a color of light from the light emitted by the light source
4. All of the above

8-33. What color CC filter should be used to remove blue light from the light produced by a color enlarger's light bulb?
1. Red
2. Cyan
3. Magenta
4. Yellow

8-34. What are the colors of the filters in a dial-in type of color enlarger?
1. Magenta, cyan, and yellow
2. Red, green, and blue
3. Cyan, red, and blue
4. Neutral density, cyan, and green

8-35. Which of the following factors is NOT a factor in altering the color quality of the exposing light from a color enlarger?
1. The CC or CP filters used
2. The lens aperture selected
3. The characteristics of the enlarger lamp
4. The amount of electrical power used to burn the lamp

8-36. What enlarger has the filters in the wrong position?



8-37. Which of the following filters is used to remove ultraviolet radiation emitted by the color enlarger's light source?
1. CC red
2. CP yellow
3. IR7
4. CP2B

8-38. A color enlarger lamp which is designed to operate on 115 volts is receiving only 95 volts. The lamp's light output color change will be about equal to a CC filter with what density?
1. 1.0
2. 9.5
3. 10.0
4. .05

● Question 8-39 is to be judged True or False.

8-39. Accurate timing of exposure for color prints is more critical than for B&W prints.

8-40. What method of color printing is used in our Navy?
1. White light
2. Tricolor

8-41. What is the final step in the negative/positive color printing procedure?
1. Exposing
2. Processing
3. Evaluating
4. Finishing

8-42. What is the most difficult step in color printing?
1. Exposing
2. Processing
3. Evaluating
4. Finishing

8-43. The green-light sensitive layer of a color negative material after processing contains what color dye image?
1. Green
2. Cyan
3. Yellow
4. Magenta

8-44. After a color negative-type film is processed, the image of a cyan subject will be recorded in which dye color layer(s) of the negative?
1. Cyan only
2. Magenta only
3. Yellow and cyan
4. Magenta and yellow

8-45. In a color negative, the image of a dark blue object will be what color?
1. Light yellow
2. Dark yellow
3. Light blue
4. Dark blue

In answering questions 8-46 through 8-51, select from column B the color of light to which the negative-type color film or paper emulsion layer in column A is sensitive.

	A. Film or Paper Layers	B. Colors of Lights
8-46.	Film top layer	1. Red
8-47.	Paper bottom layer	2. Green
8-48.	Paper middle layer	3. Blue
8-49.	Film middle layer	
8-50.	Film bottom layer	
8-51.	Paper top layer	

8-52. In which emulsion layer(s) of a color paper will the visible image of a green hat appear?
1. Top only
2. Middle
3. Bottom only
4. Top and bottom

8-53. Which of the following colors is considered cool?
1. Red
2. Magenta
3. Green
4. Blue

8-54. A high-quality color print is a satisfactory combination of which of the following variables?
1. Exposure, process, evaluation
2. Color, density, contrast
3. Composition, size, texture
4. Likeness, perspective, tricolor

8-55. Which of the following statements best describes the resulting dye image density and color of the red-light sensitive emulsion layer of a color paper print made from a color negative with very little cyan dye image density?
1. It will be low and its color will be red
2. It will be high and its color will be red
3. It will be low and its color will be cyan
4. It will be high and its color will be cyan

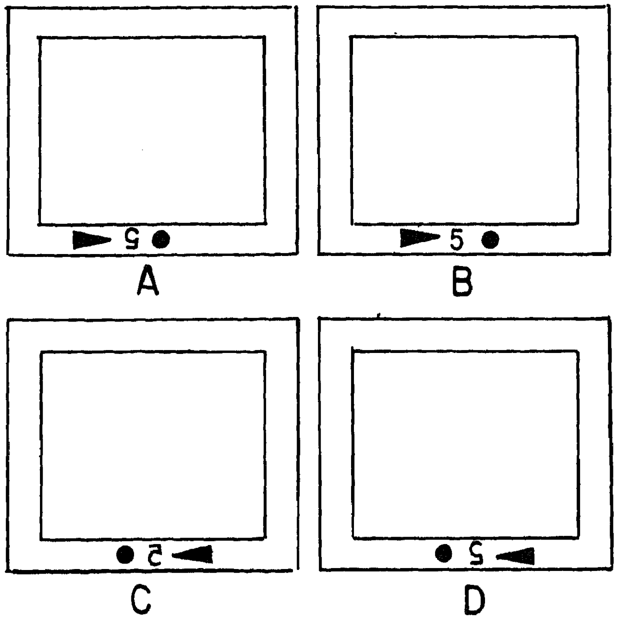


Figure 8A.--Kodak color rollfilm negatives.

● In answering question 8-56, refer to figure 8A.

8-56. Which negative is emulsion up?
1. A
2. B
3. C
4. D

● Question 8-57 is to be judged True or False.

8-57. The ultraviolet absorbing filter in a color enlarger should be placed between the light source and the negative.

8-58. When you are evaluating a color test print, the viewing light source should produce (a) what Kelvin temperature at (b) how many footcandles illuminance, and (c) what should the CRI be?
1. (a) 3950 (b) 55 (c) 90
2. (a) 4000 (b) 185 (c) 87
3. (a) 5000 (b) 100 (c) 75
4. (a) 5400 (b) 130 (c) 100

8-59. When trying to determine color balance, which of the following areas of a color test print should you evaluate?
1. Shadow
2. Highlight
3. Gray tone
4. Multicolor

8-60. The gray area of a color print is light and has a red cast to it; therefore, the light used to expose the print was deficient in what color?
1. Yellow
2. Green
3. Blue
4. Red

8-61. A color test print has excessive magenta color in the highlight areas. What color filter should be added to the printing filter pack for the reprint?
1. Magenta
2. Yellow
3. Cyan

● Question 8-62 is to be judged True or False.

8-62. When you are evaluating a color print by viewing it through a CP filter, the light incident to the print should pass through the filter while the light reflected from the print should not pass back through the filter.

8-63. When evaluating a color print which appears to be too warm, you should view it through which of the following CC filters?
1. Yellow
2. Red
3. Green
4. Magenta

8-64. Viewing a color print through a CC20R filter makes the color balance look correct. Which of the following filters should you add to the filter pack for the reprint?
1. CC20R
2. CP20C
3. CP10R
4. CP10C

In answering questions 8-65 through 8-67, select from column B the color filtration which should be added to or subtracted from the filter pack used to make the print which is over in the color listed in column A.

	A. Colors	B. Filtration Adjustments
8-65.	Red	1. Add red
8-66.	Green	2. Subtract magenta
8-67.	Blue	3. Subtract yellow
		4. Add blue

8-68. The color test print is slightly over in cyan. Which of the following filter pack adjustments should be made to make the reprint?
1. Add CP20R
2. Subtract CP20C
3. Add CC05C
4. Subtract CC05R

8-69. The color balance of a color test print is so much over in red that you cannot estimate how much. Which of the following filter pack adjustments should you make?
1. Add or subtract CC30
2. Add CC10
3. Subtract CP15Y
4. Always restart with CC50M + CC50Y

8-70. Your calculated color printing filter pack is CC10Y + CC20M + CC05C. What should your actual filter pack be for the reprint?
1. CC05Y + CC15M + CC05C
2. CC15Y + CC25M only
3. CC05Y + CC15M only
4. CC15Y + CC25M + CC10C

8-71. The exposure for a color test print was 17 seconds. After evaluating the test print, you decide to add a CP10R filter. What is the new exposure time?
1. 15.4 seconds
2. 16.9 seconds
3. 18.7 seconds
4. 22.1 seconds

8-72. The exposure for a color test print was 20 seconds. After evaluating the test print, you decide to add a CC10M filter and subtract a CC30C. What is the new exposure time?
1. 11.0 seconds
2. 18.6 seconds
3. 21.5 seconds

8-73. The color test print exposure was 27 seconds. For the reprint, a CC05Y and a CC10C filter are to be removed from the filter pack. What should be the new exposure time?
1. 20.5 seconds
2. 21.7 seconds
3. 35.6 seconds
4. 47.0 seconds

Assignment 9

Color Printing

Textbook: Pages 5-15 through 5-31

Learning Objective: Recognize the principles and procedures involved in printing color photography and be able to produce professional quality color corrected prints.

9-1. What is the purpose of a standard negative?
1. It is used as a comparison of other negative printing qualities
2. It can serve as a tool to compare the printing characteristics of different paper emulsions
3. Prints made from it can be analyzed to determine if the print process was correct
4. Each of the above

9-2. Which of the following color negatives would be suitable as a standard negative?
1. A 4x5 shot outdoors in bright sunlight
2. A 35mm shot in the CO's office with electronic flash
3. A studio portrait negative
4. All of the above

9-3. Which of the following subjects in a standard negative is most susceptible to slight color balance changes?
1. A colored shirt
2. A gray truck
3. A black hat

9-4. On a given day, a given color negative was printed on a given paper emulsion with 15M plus 25Y at f/8 for 17 seconds. Some weeks later reprints of the negative were required and because of the new paper used to print the negative the filter pack changed to 20M + 40Y. What was the exposure required to make the reprints?
1. 12.75 seconds at f/5.6
2. 12.75 seconds at f/8
3. 17.00 seconds at f/5.6
4. 17.00 seconds at f/8

9-5. Your filter pack for printing a given negative was 35Y + 40M with a particular paper emulsion and the paper filter adjustment for that emulsion was -05Y -15M. The paper filter adjustment for a new emulsion is -15Y +25M. What should your filter pack be for printing the same negative on the new emulsion?
1. 15Y + 25M
2. 25Y + 80M
3. 35Y + 40M
4. 40Y + 55M

9-6. The exposure factor for a given color paper emulsion was 85 and the exposure factor for a new emulsion is 105. What should the trial exposure time be for the new emulsion if the old emulsion exposure time was 14 seconds?
1. 11 seconds
2. 20 seconds
3. 37 seconds
4. 17 seconds

9-7. How long of a stabilization period should you give standard negative control prints?
1. 1 day
2. 2 days
3. 3 or 4 months
4. 96 hours

9-8. Standard negative control prints should be stored at what maximum temperature?
1. -10°F
2. -5°F
3. 0°F
4. 10°F

9-9. Standard negative control prints should be compared to
1. the standard negative
2. production prints
3. other control prints
4. production negatives

- Question 9-10 is to be judged True or False.

9-10. Any color negative evaluation method essentially compares the printing characteristics of the production negatives to a standard negative.

9-11. You have photographed four sailors, each with distinctly different skin tones. In the four color prints returned from the processing lab, all the sailors have the same skin tone. What is the most probable cause of this?
1. A skin tone was used for negative evaluation
2. The subject lighting was the wrong Kelvin temperature
3. The same portrait lights were used to photograph the four sailors
4. The characteristics of the negative-positive system are such that all skin tones are reproduced alike

9-12. What is the term applied to color negative printing characteristics determined by analyzing only a very small area of the negative image?
1. Spot reading
2. Centered reading
3. Select reading

9-13. When no neutral area is present in a color production negative, what type of analyzation reading can be made to determine the difference in printing properties between the production negative and a standard negative?
1. Spot
2. Small area
3. Percentage
4. Large area

- Question 9-14 is to be judged True or False.

9-14. A change in exposure time affects all three emulsion layers of a color paper.

9-15. An audiovisual facility doing which of the following volumes of color printing would probably use a filter finder for evaluating the printing characteristics of color negatives?
1. Six 8x10 prints per day
2. Seventy-three 5-inch by 2000-foot rolls per month
3. 170 various sized prints per week
4. Unlimited

9-16. Which color negative evaluation method, is most accurate?
1. Spot
2. Large area

9-17. The sailors working in the six color print rooms all get color negative evaluation information from one evaluator. What type of color negative evaluation system is probably being used?
1. One-easel
2. Off-easel
3. Filter finder kit

9-18. When a video color negative analyzer is used to determine negative printing characteristics, what is the approximate color print success rate?
1. 50 percent
2. 75 percent
3. 100 percent
4. 125 percent

9-19. To determine if exposure for the subject shadows was sufficient, a color negative should be viewed through which of the following filters?
1. CP50R
2. CCY0Y
3. No. 61
4. ND .30

9-20. A color print processing step requires 2 1/2 minutes and has a drain time of 10 seconds. What is the total processing step time?
1. 2 minutes and 10 seconds
2. 2 minutes and 20 seconds
3. 2 minutes and 30 seconds
4. 2 minutes and 40 seconds

9-21. The directions for a color process specify a developer temperature of 85°F. Which of the following temperatures can be used?
1. 84.5°F
2. 85.0°F
3. 85.5°F
4. All of the above

9-22. From what color processing solution is silver usually reclaimed?
1. Developer
2. Stop bath
3. Bleach-fix
4. Stabilizer

9-23. When a bleach-fix regeneration system is used, about what percent of the original bleach-fix will be available for reuse as a replenisher?
1. 20 percent
2. 40 percent
3. 60 percent
4. 80 percent

9-24. To what color(s) of light are (a) regular black and white and (b) Pamalure printing paper sensitive?
1. (a) Red, green, and blue
   (b) red, green, and blue
2. (a) Red, green, and blue
   (b) cyan, magenta, and yellow
3. (a) Blue only
   (b) red, green, and blue
4. (a) Red, green, and blue,
   (b) red only

9-25. When printing color negatives onto Panalure paper, which of the following filters should you use to create (a) a slight change and (b) a major change to the tonal rendition?
1. (a) No. 12 (b) No. 25
2. (a) No. 25 (b) CP50Y
3. (a) CC40M (b) CC20Y
4. (a) CC40R (b) No. 61

9-26. You are making B&W prints from color negatives onto Panalure paper and want to reproduce the gray tone print image of a cyan negative image light. Which of the following filters should you use?
1. CC10B
2. CC10C
3. CC10G
4. CC10R

9-27. You are making B&W prints from color negatives onto Panalure paper and want to reproduce the gray tone print image of a magenta negative image light. Which of the following filters should you use?
1. CC20M
2. CC20B
3. No. 52
4. No. 25

9-28. Which of the following safelight filters should be used for printing Panalure paper?
1. No. 15
2. No. 7 1/2
3. Light blue
4. Deep amber

● Questions 9-29 and 9-30 are to be judged True or False.

9-29. The film being used to make color slides from color negatives should have its emulsion facing the negative's emulsion during exposure.

9-30. Color film which has been processed in D-76 cannot be used to make prints.

9-31. Color prints can NOT be made from which of the following films processed in a B&W developer?
1. Vericolor
2. Ektachrome
3. Kodachrome

9-32. When color negative film has been processed as B&W, what type of paper should you use to make B&W prints?
1. Vericolor
2. Ektacolor
3. Kodacolor
4. Panalure

● Questions 9-33 and 9-34 are to be judged True or False.

9-33. High quality color prints can be made from color negatives only.

9-34. A very contrasty color slide cannot be printed in color.

9-35. The light used to evaluate color prints for proper color balance should have a CRI of at least which of the following values?
1. 110
2. 154
3. 175
4. 200

9-36. What is the required range of illumination intensity in footcandles for evaluating the color balance of color prints?
1. 55 to 130
2. 75 to 185
3. 130 to 185
4. 185 to 240

9-37. There is a total of how many emulsion layers in color reversal paper?
1. One
2. Two
3. Three
4. Four

9-38. In a color reversal paper, what colors are the dye images?
1. Red, green, and blue
2. Red and magenta only
3. Blue and yellow only
4. Cyan, magenta, and yellow

● Question 9-39 is to be judged True or False.

9-39. Color reversal paper, unlike black and white paper, is not processed to a silver image.

9-40. What color print process uses the "dye destruction" method of reproducing color slide images?

1. Cibachrome
2. Ektachrome
3. Ektacolor
4. Pamalure

Questions 9-41 and 9-42 are to be judged True or False.

9-41. When evaluating the density of a color print made from a duplicate slide, it should be compared to the original slide and not the duplicate which will have high contrast.

9-42. The color quality of a color print should be compared to the color quality of the slide used to make the print.

9-43. When subjectively analyzed, a color print made from a color slide is over in red. What color filtration should you add to the filter pack for the reprint?

1. Magenta
2. Green
3. Red
4. Cyan

9-44. A reversal color print has excess cyan color. Which of the following filter pac changes should you make for the reprint?

1. Add cyan filtration
2. Subtract yellow and magenta filtratio
3. Subtract cyan filtration
4. Add yellow and magenta filtration

9-45. A reversal color print has excess cyan color. Which of the following filter pac changes should you make for the reprint?

1. Add green and blue filtration
2. Subtract yellow and magenta filtratio
3. Add cyan filtration
4. Add yellow and magenta filtration

Assignment 10

Machine Processing and Equipment Maintenance

Textbook: Pages 6-1 through 6-38

Learning Objective: Recognize functions, construction features, operating characteristics and procedures, and maintenance practices applicable to film and paper processing machines and their components.

10-1. As a film processing machine operator, you may be expected to perform which of the following tasks?

1. Cleaning the processor
2. Making corrective adjustments
3. Inserting film
4. All of the above

● Question 10-2 is to be judged True or False.

10-2. The most efficient film processing by machine is accomplished when the film is in short lengths and better yet when the film is in sheets.

10-3. Which of the following factors determines the processing time in machine processing?

1. Depth of processing tanks
2. The distance the film must travel
3. The machine speed
4. Each of the above

10-4. Which of the following publications should you consult for information and specifications for space requirements for automatic film processing machine installation requirements?

1. The manufacturer's installation and service requirements
2. The U.S. Navy Standard Installation Manual
3. A processing standards manual
4. The Naval Engineering Command "Installation Requirements for Navy Audiovisual Activities Ashore and Afloat"

10-5. When processing photographic material in an automatic processor, which of the following is NOT considered a processing variable?

1. Solution temperature
2. Machine speed
3. Subject lighting ratio
4. Replenishment rate

10-6. What unit of measure is used to express film processing time in an automatic roller transport processing machine?

1. Feet-per-minute
2. Time in/out
3. Rate of travel
4. Roller rack rotation

10-7. A fixing tank in a paper processor holds 18 feet of paper. If the machine is operated at 7.5 feet per minute, what is the fixing time?

1. 1.8 minutes
2. 2.4 minutes
3. 3.2 minutes
4. 4.1 minutes

10-8. The developer and fixer solutions in a B&W film processor must be used at a temperature of 86°F. At what temperature should the wash water be?

1. 68°F
2. 75°F
3. 86°F

● Question 10-9 is to be judged True or False.

10-9. Because aerial film is processed very quickly in an automatic processor, developer temperature is not as critical as it is in hand processing.

10-10. Why are air squeegees generally NOT used at the developer tank exit of an automatic film processing machine?
1. Developer oxidation is apt to occur
2. Air impingement at this point will strip the emulsion from the film base
3. Any dust or dirt in the air would become imbedded in the emulsion

10-11. For which of the following reasons should the solution levels in the tanks of a film processor be kept full?
1. The automatic cutoff float switch will be activated
2. Oxidation will occur
3. Processing time is dependent on solution volume
4. Solution strength is dependent on solution level

10-12. Which, if any, of the following, is the result of excessive bromide in the developer tank of an automatic film processor?
1. Increased solution activity
2. Decreased solution activity
3. Developer oxidation
4. None of the above

Question 10-13 is to be judged True or False.

10-13. Because a paper processing machine is a closed system, evaporation cannot be a cause of solution loss.

10-14. What type of solution filtration, is recommended for automatic film processors?
1. Continuous
2. Batch

10-15. Which of the following processing faults will cause film to curl?
1. Low wash water temperature
2. High developer concentration
3. Overdrying
4. Excess roll takeup pressure

Question 10-16 is to be judged True or False.

10-16. Film which is dried too fast may become brittle. However, this condition can be overcome by treating the dry film in a moisture-retaining solution and redrying the film at a slower rate.

10-17. In an automatic film processor that uses friction to move material being processed, friction is applied to which side of the material?
1. Base
2. Emulsion

10-18. When a processing machine dryer is cooling down, at what temperature the blower first be shut off?
1. 98°F
2. 105°F
3. 110°F
4. 125°F

10-19. During shutdown of a leadered proc machine, why is the wash water tur off after material transport has stopped?
1. Water cools the material
2. Water is carried out by the ma and causes overheating of solu
3. Water serves as a lubricant fo material being transported
4. Water washes solutions from th material

10-20. What is generally the last process machine shutdown step?
1. Secure replenishment
2. Turn off water
3. Stop heater blower
4. Shut off heater

10-21. What are the two types of equipmen maintenance usually practiced by N photographers?
1. Repairing and overhauling
2. Reclaiming and modifying
3. Inspecting and testing
4. Preventive and corrective

10-22. What type of maintenance leads to detection of future possible break
1. Preventive
2. Corrective
3. Modifying
4. Servicing

10-23. During the processing of high-prio aerial reconnaissance film, the ma drive shaft of the processor break What type of maintenance will be u put the machine back in operation quickly as possible?
1. Flash repair
2. Corrective
3. Quick fix
4. Malfunction elimination

10-24. What instruction should you consul regard to aviation maintenance management?
1. OPNAVINST 4790.4
2. NAVAIRSYSCOM 3156.4
3. OPNAVINST 4790.2
4. OPNAVINST 5290.1

● Question 10-25 is to be judged True or False.

10-25. Photographers involved in equipment maintenance will always be guided by the Ships' 3-M Program.

10-26. What is the primary purpose of the 3-M Systems?
1. Maintenance management
2. Material management
3. Data processing
4. Equipment readiness

10-27. Within the 3-M organization, who is the head policymaker?
1. CNO
2. TYCOM
3. CO

10-28. Who is responsible for ensuring that the 3-M Systems procedures are followed aboard ship?
1. The commanding officer
2. The executive officer
3. The department head
4. The work center supervisor

10-29. Who is the chairman of 3-M meetings involving department heads and the 3-M coordinator?
1. The commanding officer
2. The executive officer
3. The maintenance officer
4. The 3-M coordinator

10-30. Who serves as the 3-M assistant to the executive officer?
1. All department heads
2. Work center supervisors
3. The 3-M coordinator
4. All departmental 3-M assistants

10-31. Who is responsible for ensuring that the supply departments MRC deck is up to date?
1. The 3-M coordinator
2. The supply division officer
3. The supply work center supervisor
4. The supply officer

10-32. Within the photo lab, who is responsible for supervising the preparation of the 3-M Weekly Schedules?
1. The senior CPO
2. The production PO
3. The maintenance PO
4. The division officer

10-33. What is the title of a petty officer who oversees the 3-M functions of several work centers?
1. Group supervisor
2. 3-M coordinator
3. Work centers supervisor
4. Multifunction supervisor

10-34. Which of the following sailors who work in the B&W print room would be the 3-M System's work center supervisor for that work center?
1. PHC Donigan
2. PH1 Wollitz
3. PH2 Guest
4. PH3 Armstrong

10-35. Which of the following sailors who work in the B&W print room is responsible for ensusring that 3-M supplies are available in the print room?
1. PHC Donigan
2. PH1 Wollitz
3. PH2 Guest
4. PH3 Armstrong

10-36. Which of the following abbreviations is not applicable to the 3-M Program?
1. CSMP
2. TTL
3. FBR
4. JSN

10-37. The planning, scheduling, and control of equipment maintenance falls under what subsystem of the 3-M Program?
1. PSC
2. MRC
3. PMS
4. EGL

10-38. Which of the following documents lists the MIPs for a given department?
1. EGL
2. MRC
3. PMS
4. LOEP

10-39. Which of the following 3-M documents should you use as a guide when performing equipment maintenance?
1. FBR
2. MRC
3. MIP
4. LOEP

10-40. Which of the following 3-M documents gives a list of tools required for the maintenance of a given equipment?
1. FBR
2. MRC
3. MIP
4. LOEP

10-41. Which of the following schedules is NOT a part of the PMS?
1. Cycle
2. Quarterly
3. Weekly
4. Daily

10-42. How often should the quarterly PMS schedule be updated?
1. Daily
2. Weekly
3. Quarterly
4. Annually

10-43. What category FBR is used to order MRCs?
1. A
2. B
3. C
4. D

10-44. What category FBR is used for technical purposes?
1. A
2. B
3. C
4. D

10-45. What category FBR is used to report maintenance safety inadequacies?
1. A
2. B
3. C
4. D

10-46. For the PMS to be efficient, which of the following persons must be involved in the supervision of the 3-M program?
1. Commanding officer
2. Division officer
3. Work center supervisor
4. All of the above

10-47. The audiovisual division officer should make a minimum of (a) how many PMS performance evaluations per work center and (b) how often should they be made?
1. (a) Two (b) annually
2. (a) Two (b) quarterly
3. (a) One (b) weekly
4. (a) One (b) daily

10-48. Providing the necessary information which will help to improve the usefulness of equipment is an objective of what part of the 3-M Program?
1. SFDMS
2. INSURV
3. MDS
4. PMS

10-49. What type of maintenance action is submitted when the ship's crew makes a configuration change to an EH-38D?
1. Completed
2. Deferred

● Questions 10-50 through 10-52 are to be judged True or False.

10-50. Although a Royalprint processor was operating correctly, you replaced a worn part; therefore, the part must be reported as a failed part.

10-51. A PHAN who recently graduated from PH "A" School tells you she did not receive any 3-M training at "A" School. She is probably lying to you.

10-52. During actual maintenance of a photographic processor, you are permitted to conduct 3-M OJT.

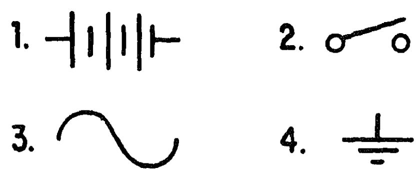
10-53. Which of the following senses is/are used in troubleshooting?
1. Hearing
2. Sight
3. Feel
4. All of the above

● Question 10-54 is to be judged True or False.

10-54. All electrical diagrams are a form of schematic.

10-55. What is the simplest type of electrical diagram?
1. Isometric
2. Block
3. Pictorial
4. Single line

10-56. Which is the symbol for a battery?



10-57. What type of electrical diagram uses symbols rather than labeled blocks?
1. Single line
2. Block

10-58. What type of electrical diagram shows equipment components in their proper relationship to one another?
1. Single line
2. Schematic
3. Wiring
4. Isometric

● In answering question 10-59, refer to the wiring diagram shown on page 6-34 of the textbook.

10-59. What color is the clock wire?

1. Green
2. Black-blue
3. Yellow-red
4. Red

Assignment 11

Audiovisual Administration

Textbook: Pages 7-1 through 7-13

Learning Objective: Recognize the chain of command for administrative control and understand the mission of Navy audiovisual activities.

11-1. Navy audiovisual managers should be guided by what instruction?
1. Navy Audiovisual Management and Operations Manual
2. NAVAIRINST 10700.2
3. Manual of Naval Photography

11-2. The use of AV products in the Navy is governed by which of the following instructions?
1. NAVEDTRA 13014
2. OPNAVINST 5290.1
3. SECNAVINST 3150.6
4. NAVAIRSYSCOMINST 10700.2

11-3. Who is responsible to the CNO for the NAVAP?
1. OP-007D
2. CO NAVAVCEN
3. CHINFO
4. COs of the Atlantic and Pacific fleet audiovisual commands

11-4. Where is the Navy Audiovisual Center located?
1. San Diego, CA
2. Norfolk, VA
3. Pensacola, FL
4. Washington, DC

11-5. Which of the following commands, when authorized, may operate a Base Audiovisual Service Center?
1. The Atlantic Fleet Audiovisual Command
2. The Pacific Fleet Audiovisual Command
3. A U.S. Naval Air Station
4. All of the above

- Questions 11-6 and 11-7 are to be judged True or False.

11-6. A Base Audiovisual Service Center can be the only authorized management activity for AV production in a geographic area.

11-7. All assets of a BAVSC must be physically located in one building.

11-8. Which, if any, of the following DODAVANs may be used to identify a Base Audiovisual Service Center Detachment?
1. N0108
2. D0108
3. N0108(D)
4. None of the above

11-9. The Naval Air Station, Pensacola, FL does not operate a BAVSC. What other type of AV facility might the CO be authorized to operate?
1. MDAVF
2. NAVF
3. BAVSCD

- Question 11-10 is to be judged True or False.

11-10. A PH2 who is trained in TARPS camera installation should be assigned to the ship's photo lab when his F-14 squadron comes aboard the ship.

11-11. As the training PO in a BAVSC, your primary objective in training selected reserve personnel should be to train them for their
1. advancement
2. OJT requirements
3. mobilization billets
4. mobilization training

11-12. OJT of PHs should be directed primarily toward which of the following goals?
1. The unit's mission
2. Advancement
3. The person's career progression
4. All of the above

11-13. Where is the Naval Schools of Photography located?
1. Orlando, FL
2. Jacksonville, FL
3. Pensacola, FL
4. Key West, FL

● Questions 11-14 and 11-15 are to be judged True or False.

11-14. According to the text, Navy civilians may not attend the Naval Schools of Photography.

11-15. Only official AV support functions may be carried out in a Navy AV facility.

11-16. Which of the following forms should generally be used to request AV products?
1. DOD Form 3150
2. AIR-10700
3. OPNAV Form 5290/1

● Question 11-17 is to be judged True or False.

11-17. An MDAVF may not accept letter requests for AV products whereas a BAVSC may.

11-18. The work request number in a SAVWRN will consist of how many digits?
1. 17
2. 9
3. 7
4. 5

11-19. What is the DOD-type work code for still photography
1. SP
2. STPH
3. PH

Learning Objective: Identify the regulations related to classification and security matters.

11-20. With regard to security of classified photographs, your primary source of information should be which of the following publications?
1. Manual of Naval Security
2. PH rate training series, Module 3
3. Department of the Navy Information and Security Program Regulation
4. Navy Audiovisual Management and Operations Manual

● Question 11-21 is to be judged True or False.

11-21. Only those PHs who have a security clearance are responsible for safeguarding classified material.

11-22. There is a total of how many security classifications?
1. One
2. Two
3. Three
4. Four

11-23. What is the highest security classification?
1. Cryptographic
2. Confidential
3. Secret
4. Top Secret

11-24. At a beach party, you shot several photographs of female naval officers swimming and sunning in the nude. These pictures could be detrimental to their service careers and cause them much embarrassment. How, if at all, should these pictures be classified?
1. Confidential
2. For Official Use Only
3. Secret
4. They should not be classified

11-25. Classified 8x10-inch prints should have the classification marked on them in a minimum of how many places?
1. One
2. Two
3. Three
4. Four

11-26. A classification marking must be placed on which side of a photograph?
1. Front
2. Back

● Question 11-27 is to be judged True or False.

11-27. A 35mm slide must have a security classification marking in the image area.

11-28. A photograph was classified Secret on 15 March 1983. When will the photograph be automatically downgraded to Confidential?
1. 1 January 1986
2. 1 January 1985
3. 15 March 1985
4. 15 March 1991

11-29. As a Photographer's Mate, you will protect classified material by what two primary means?
1. Censorship and transmission security
2. Cryptographic and transmission security
3. Physical and cryptographic security
4. Censorship and physical security

● Question 11-30 is to be judged True or False.

11-30. Two persons must witness the destruction of Top Secret material, only one of which needs to have a Top Secret clearance.

11-31. The destruction of which of the following classified material need NOT be recorded?
1. Confidential
2. Secret
3. Top Secret

11-32. For a minimum of how many years must a record of destruction of classified material be kept?
1. 1 year
2. 2 years
3. 3 years
4. 4 years

11-33. Which of the following notices should be posted at the entrance to the production area of an audiovisual facility?
1. EXCLUSION AREA
2. LIMITED AREA
3. RESTRICTED AREA
4. CONTROLLED AREA

11-34. Who is directly responsible for safeguarding classified material in an audiovisual facility?
1. The commanding officer
2. The audiovisual manager
3. The security officer
4. The Top Secret Security control officer

11-35. Which of the following markings should be placed on a safe used to hold classified negatives?
1. Secret
2. III
3. ★
4. Both 2 and 3 above

11-36. At least how often must the combinatio to a safe used to store classified material be changed?
1. Annually
2. Semiannually
3. Quarterly
4. Monthly

11-37. Which of the following combinations ma be used for a safe used for the storag of Top Secret material?
1. 5-10-15
2. 15-5-10
3. 12-47-9
4. 2-6-10

11-38. Which of the following combinations ma be used for a safe used for the storag of Secret material?
1. 5-10-15
2. 15-5-10
3. 12-47-9
4. 2-6-10

11-39. Which of the following combinations ma be used for a safe used for the storag of Confidential material?
1. 5-10-15
2. 15-5-10
3. 12-47-9
4. 2-6-10

11-40. A receipt must be prepared whenever material with what classification changes hands?
1. Top Secret
2. Secret
3. Confidential
4. All of the above

Assignment 12

Audiovisual Supply

Textbook: Pages 8-1 through 8-30

Learning Objective: Recognize the importance of the Navy supply system and identify some of the organizational roles and functions within the system.

- Question 12-1 is to be judged True or False.

12-1. Civilian government agencies may provide your AV center with some of the materials you need.

12-2. Within the Navy there are how many "Systems Commands"?
1. Nine
2. Seven
3. Five
4. Four

12-3. As a Photographer's Mate, you should be most familiar with what two systems commands?
1. Air and Electronics
2. Sea and Supply
3. Air and Supply
4. Facilities Engineering and Air

12-4. Who is/are the inventory manager(s) for photographic equipment?
1. Commanding Officer, Naval Audiovisual Center
2. Commanding officers of the fleet audiovisual commands
3. Commander, Naval Supply Systems Command
4. Commander, Naval Air Systems Command

12-5. Which of the following places is NOT a stock point?
1. Headquarters, Commander, Naval Air Systems Command, Inventory Management Office
2. A naval supply center
3. A naval supply depot
4. An industrial naval air station

- Questions 12-6 through 12-10 are to be judged True or False.

12-6. NAS Pensacola is considered a stock point.

12-7. The General Services Administration is an agency of the Department of Defense.

12-8. The General Services Administration can furnish supplies to the Department of Defense but not directly to the Navy.

12-9. A local photographic retail store carries film which is listed in a GSA Schedule. The retailer must sell the film to the Navy at the agreed GSA price.

12-10. The GSA price for AV equipment is always lower than the Navy stock price.

12-11. Within the Federal Supply Classification System, under what group are photographic materials carried?
1. 2W
2. 00
3. 67
4. JX

12-12. What is the FSC number for a still picture camera?
1. 6750
2. 6730
3. 6720
4. 6710

12-13. Which segment of the NSN 2WH6730-00-643-9781-JX is the NIIN?
1. 2VH6730
2. 00
3. 632-9781
4. 00-643-9781

12-14. Material which is stocked at a Navy stock point but is not in the Federal Catalog System is assigned what type of identification number?
1. Navy Item Control
2. Local Item Control
3. Material Control Code
4. Special Material Identification Code

12-15. The material identification number 6720-LL-791-9296 is what type of number?
1. Navy Item Control
2. Local Item Control
3. Material Control Code
4. Special Material Identification Code

Learning Objective: Identify some of the principal supply publications, their purpose and general content.

12-16. Which of the following publications should you consult to find an NSN for a manufacturer's given part number for a camera part?
1. Management List - Navy
2. Afloat Shopping Guide
3. Consolidated Master Cross-Reference List
4. Photographic Equipment List

12-17. What publication should you consult to find a list of all current photographic equipment lists?
1. Navy Audiovisual Management and Operations Manual
2. Manual of Naval Photography
3. DOD Consolidated Federal Supply Catalog
4. List of Navy Publications

12-18. As a photographer, which part of the Navy Stock List will you probably use most?
1. ASO E-6789
2. C-0001
3. FSC 6750
4. 6700IL

12-19. Which of the following publications should you consult to determine what AV equipment your unit is authorized to have in its inventory?
1. Photographic Equipment List
2. Allowance Lists
3. Management List - Navy
4. Afloat Shopping Guide

12-20. What is the NAVSUP number of the "I Cog Catalog"?
1. E-6789
2. C-0001
3. P-2002
4. 00-35QP

● Questions 12-21 through 12-23 are to be judged True or False.

12-21. Load lists are published only for Logistics Support Force Ships.

12-22. Because of the vast amount of data supplied to the Navy supply system, a manufacturer's part number in and of itself can be used to determine the correct NSN for the part in question.

12-23. Because manufacturers of photographic processing machines supply these machines to both government and civilian processing labs, they do not include NSNs on the equipment nameplates.

Learning Objective: Identify terms and forms used in procurement.

12-24. By which of the following official methods do audiovisual units get the materials they need?
1. Purchase
2. Requisition
3. Both 1 and 2 above
4. Direct

12-25. Which of the following forms is/are usually used to requisition film?
1. DD Form 1149
2. DD Form 1348
3. Both 1 and 2 above
4. NAVAIR Form 5290

12-26. Your unit ordered 4000 rolls of 35mm film. However, the supply point only shipped 3840 rolls and cancelled the rest of the order. Which of the following terms is applicable to this transaction?
1. Exception Status
2. Cancellation
3. Material Obligation Validation
4. 100% Supply Status

● Question 12-27 is to be judged True or False.

12-27. DD Form 1348 should always be made out with a typewriter.

12-28. What would be the UND for a routine requisition?
1. A
2. B
3. C

12-29. Your unit has been assigned a F/AD "III." What is the priority for a routine requisition?
1. 03
2. 06
3. 11
4. 13

12-30. In which publication is afloat MILSTRIP?
1. NAVSUP P-485
2. NAVSUP P-437
3. NAVSUP 1149
4. NAVSUP 1348

12-31. What is the proper term to describe a requisition used to "buy" material from SERVMART?
1. Procurement Requisition
2. SERVMART Chit
3. Money Value Only Requisition

12-32. What type of form is used for requisitioning material from SERVMART?
1. 1149
2. Consumable
3. Equipage
4. 1348

12-33. What document identifier is assigned to a requisition followup?
1. AF1
2. A1F
3. 1AF
4. FA1

12-34. What is the maximum amount of dollars that may be expended from the imprest fund for nonemergency purchases?
1. $ 150
2. $ 300
3. $ 350
4. $2500

Learning Objective: Identify inventory procedures for controlled equipage and expendable supplies.

12-35. Which of the following instructions deals with the accountability of class 6700 equipage?
1. OPNAVINST 3150.6
2. NAVSUPINST 10978
3. OPNAVINST 10700.1
4. OPNAVINST 5290.1

12-36. An automatic film processing machine is what class plant property?
1. 1
2. 2
3. 3
4. 4

12-37. On which of the following NAVSUP forms should you enter inventory counts?
1. 1149
2. 1348
3. 10700
4. 766

● Question 12-38 is to be judged True or False.

12-38. When the quantity for a type of film stocked is "2," the established low limit for the film is "2."

● In answering questions 12-39 through 12-41, use the following information:

Your unit uses 75 rolls of a given film per month. The safety level is 4 months while the stocking objective is 6 months. Order and shipping time is 1 month.

12-39. What is the operating level in (a) months and (b) in the number of rolls of film?
1. (a) 1 (b) 100
2. (a) 2 (b) 150
3. (a) 3 (b) 200
4. (a) 4 (b) 250

12-40. What is the high level in (a) the number of rolls and (b) in months?
1. (a) 525 (b) 7
2. (a) 500 (b) 6
3. (a) 475 (b) 5
4. (a) 450 (b) 4

12-41. What is the low limit in number of rolls?
1. 325
2. 350
3. 375
4. 400

12-42. What are the NAVSUP Form numbers for "custody cards"?
1. 1348 and 1149
2. 1114 and 767
3. 766 and 306
4. 306 and 460

12-43. As a minimum, how often should controlled equipage be inventoried?
1. Monthly
2. Quarterly
3. Semiannually
4. Annually

12-44. An inventory of controlled equipage must be held during which of the following time frames?
1. 1 Jan to 15 Jan
2. 15 Jan to 30 Jan
3. 15 Feb to 30 Feb
4. 15 Mar to 15 Apr

● Question 12-45 is to be judged True or False.

12-45. Because an exposure meter with the serial number 1772 which costs $46.80 was lost during an official assignment. an MLSR must be submitted.

COURSE DISENROLLMENT

All study materials must be returned. On disenrolling, fill out only the upper part of this page and attach it to the inside front cover of the textbook for this course. Mail your study materials to the Naval Education and Training Program Development Center.

PRINT CLEARLY

NAVEDTRA NUMBER — COURSE TITLE

373-03-45-83 — NAVY PHOTOGRAPHER'S MATE MODULE 3

Name Last First Middle

Rank/Rate Designator Social Security Number

COURSE COMPLETION

Letters of satisfactory completion are issued only to personnel whose courses are administered by the Naval Education and Training Program Development Center. On completing the course, fill out the lower part of this page and enclose it with your last set of answer sheets. Be sure mailing addresses are complete. Mail to the Naval Education and Training Program Development Center.

PRINT CLEARLY

NAVEDTRA NUMBER — COURSE TITLE

373-03-45-83 — NAVY PHOTOGRAPHER'S MATE MODULE 3

Name

ZIP CODE

MY SERVICE RECORD IS HELD BY:

Activity

Address ZIP CODE

Signature of enrollee

A FINAL QUESTION: What did you think of this course? Of the text material used with the course? Comments and recommendations received from enrollees have been a major source of course improvement. You and your command are urged to submit your constructive criticisms and your recommendations. This tear-out form letter is provided for your convenience. Typewrite if possible, but legible handwriting is acceptable.

Date ____________________

From: ____________________________________
(RANK, RATE, CIVILIAN)

____

____________________________________ ZIP CODE __________

To: Naval Education and Training Program Development Center (PD 10)
Pensacola, Florida 32509

Subj: Navy Photographer's Mate Module 3, NAVEDTRA 373-03-45-83

1. The following comments are hereby submitted:

(Fold along dotted line and staple or tape)

(Fold along dotted line and staple or tape)

NAVAL EDUCATION AND TRAINING PROGRAM DEVELOPMENT CENTER
BUILDING 2435 (PD 10)
PENSACOLA, FLORIDA 32509

PRINT OR TYPE

NAVY PHOTOGRAPHER'S MATE MODULE 3
NAVEDTRA 373-03-45-83

NAME ______________________________ ADDRESS ______________________________
Last First Middle Street/Ship/Unit/Division, etc.

____
City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ____________________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ____________ DATE MAILED ________

SCORE

	1 T	2 F	3	4			1 T	2 F	3	4			1 T	2 F	3	4	
1	☐	☐	☐	☐	_ _ _ _ _	26	☐	☐	☐	☐	_ _ _ _ _	51	☐	☐	☐	☐	_ _ _ _ _
2	☐	☐	☐	☐	_ _ _ _ _	27	☐	☐	☐	☐	_ _ _ _ _	52	☐	☐	☐	☐	_ _ _ _ _
3	☐	☐	☐	☐	_ _ _ _ _	28	☐	☐	☐	☐	_ _ _ _ _	53	☐	☐	☐	☐	_ _ _ _ _
4	☐	☐	☐	☐	_ _ _ _ _	29	☐	☐	☐	☐	_ _ _ _ _	54	☐	☐	☐	☐	_ _ _ _ _
5	☐	☐	☐	☐	_ _ _ _ _	30	☐	☐	☐	☐	_ _ _ _ _	55	☐	☐	☐	☐	_ _ _ _ _
6	☐	☐	☐	☐	_ _ _ _ _	31	☐	☐	☐	☐	_ _ _ _ _	56	☐	☐	☐	☐	_ _ _ _ _
7	☐	☐	☐	☐	_ _ _ _ _	32	☐	☐	☐	☐	_ _ _ _ _	57	☐	☐	☐	☐	_ _ _ _ _
8	☐	☐	☐	☐	_ _ _ _ _	33	☐	☐	☐	☐	_ _ _ _ _	58	☐	☐	☐	☐	_ _ _ _ _
9	☐	☐	☐	☐	_ _ _ _ _	34	☐	☐	☐	☐	_ _ _ _ _	59	☐	☐	☐	☐	_ _ _ _ _
10	☐	☐	☐	☐	_ _ _ _ _	35	☐	☐	☐	☐	_ _ _ _ _	60	☐	☐	☐	☐	_ _ _ _ _
11	☐	☐	☐	☐	_ _ _ _ _	36	☐	☐	☐	☐	_ _ _ _ _	61	☐	☐	☐	☐	_ _ _ _ _
12	☐	☐	☐	☐	_ _ _ _ _	37	☐	☐	☐	☐	_ _ _ _ _	62	☐	☐	☐	☐	_ _ _ _ _
13	☐	☐	☐	☐	_ _ _ _ _	38	☐	☐	☐	☐	_ _ _ _ _	63	☐	☐	☐	☐	_ _ _ _ _
14	☐	☐	☐	☐	_ _ _ _ _	39	☐	☐	☐	☐	_ _ _ _ _	64	☐	☐	☐	☐	_ _ _ _ _
15	☐	☐	☐	☐	_ _ _ _ _	40	☐	☐	☐	☐	_ _ _ _ _	65	☐	☐	☐	☐	_ _ _ _ _
16	☐	☐	☐	☐	_ _ _ _ _	41	☐	☐	☐	☐	_ _ _ _ _	66	☐	☐	☐	☐	_ _ _ _ _
17	☐	☐	☐	☐	_ _ _ _ _	42	☐	☐	☐	☐	_ _ _ _ _	67	☐	☐	☐	☐	_ _ _ _ _
18	☐	☐	☐	☐	_ _ _ _ _	43	☐	☐	☐	☐	_ _ _ _ _	68	☐	☐	☐	☐	_ _ _ _ _
19	☐	☐	☐	☐	_ _ _ _ _	44	☐	☐	☐	☐	_ _ _ _ _	69	☐	☐	☐	☐	_ _ _ _ _
20	☐	☐	☐	☐	_ _ _ _ _	45	☐	☐	☐	☐	_ _ _ _ _	70	☐	☐	☐	☐	_ _ _ _ _
21	☐	☐	☐	☐	_ _ _ _ _	46	☐	☐	☐	☐	_ _ _ _ _	71	☐	☐	☐	☐	_ _ _ _ _
22	☐	☐	☐	☐	_ _ _ _ _	47	☐	☐	☐	☐	_ _ _ _ _	72	☐	☐	☐	☐	_ _ _ _ _
23	☐	☐	☐	☐	_ _ _ _ _	48	☐	☐	☐	☐	_ _ _ _ _	73	☐	☐	☐	☐	_ _ _ _ _
24	☐	☐	☐	☐	_ _ _ _ _	49	☐	☐	☐	☐	_ _ _ _ _	74	☐	☐	☐	☐	_ _ _ _ _
25	☐	☐	☐	☐	_ _ _ _ _	50	☐	☐	☐	☐	_ _ _ _ _	75	☐	☐	☐	☐	_ _ _ _ _

PRINT OR TYPE

NAVY PHOTOGRAPHER'S MATE MODULE 3
NAVEDTRA 373-03-45-83

NAME ______________________________ ADDRESS ______________________________

Last First Middle — Street/Ship/Unit/Division, etc.

City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ______________________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ______________ DATE MAILED ________

SCORE

1 T	2 F	3	4		1 T	2 F	3	4		1 T	2 F	3	4
1					26					51			
2					27					52			
3					28					53			
4					29					54			
5					30					55			
6					31					56			
7					32					57			
8					33					58			
9					34					59			
10					35					60			
11					36					61			
12					37					62			
13					38					63			
14					39					64			
15					40					65			
16					41					66			
17					42					67			
18					43					68			
19					44					69			
20					45					70			
21					46					71			
22					47					72			
23					48					73			
24					49					74			
25					50					75			

PRINT OR TYPE

NAVY PHOTOGRAPHER'S MATE MODULE 3
NAVEDTRA 373-03-45-83

NAME ______________________________ ADDRESS ______________________________
Last First Middle — Street/Ship/Unit/Division, etc.

____
City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ______________________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ________________ DATE MAILED ________

SCORE

	1 T	2 F	3	4			1 T	2 F	3	4			1 T	2 F	3	4	
1	☐	☐	☐	☐	_ _ _ _ _	26	☐	☐	☐	☐	_ _ _ _ _	51	☐	☐	☐	☐	_ _ _ _ _
2	☐	☐	☐	☐	_ _ _ _ _	27	☐	☐	☐	☐	_ _ _ _ _	52	☐	☐	☐	☐	_ _ _ _ _
3	☐	☐	☐	☐	_ _ _ _ _	28	☐	☐	☐	☐	_ _ _ _ _	53	☐	☐	☐	☐	_ _ _ _ _
4	☐	☐	☐	☐	_ _ _ _ _	29	☐	☐	☐	☐	_ _ _ _ _	54	☐	☐	☐	☐	_ _ _ _ _
5	☐	☐	☐	☐	_ _ _ _ _	30	☐	☐	☐	☐	_ _ _ _ _	55	☐	☐	☐	☐	_ _ _ _ _
6	☐	☐	☐	☐	_ _ _ _ _	31	☐	☐	☐	☐	_ _ _ _ _	56	☐	☐	☐	☐	_ _ _ _ _
7	☐	☐	☐	☐	_ _ _ _ _	32	☐	☐	☐	☐	_ _ _ _ _	57	☐	☐	☐	☐	_ _ _ _ _
8	☐	☐	☐	☐	_ _ _ _ _	33	☐	☐	☐	☐	_ _ _ _ _	58	☐	☐	☐	☐	_ _ _ _ _
9	☐	☐	☐	☐	_ _ _ _ _	34	☐	☐	☐	☐	_ _ _ _ _	59	☐	☐	☐	☐	_ _ _ _ _
10	☐	☐	☐	☐	_ _ _ _ _	35	☐	☐	☐	☐	_ _ _ _ _	60	☐	☐	☐	☐	_ _ _ _ _
11	☐	☐	☐	☐	_ _ _ _ _	36	☐	☐	☐	☐	_ _ _ _ _	61	☐	☐	☐	☐	_ _ _ _ _
12	☐	☐	☐	☐	_ _ _ _ _	37	☐	☐	☐	☐	_ _ _ _ _	62	☐	☐	☐	☐	_ _ _ _ _
13	☐	☐	☐	☐	_ _ _ _ _	38	☐	☐	☐	☐	_ _ _ _ _	63	☐	☐	☐	☐	_ _ _ _ _
14	☐	☐	☐	☐	_ _ _ _ _	39	☐	☐	☐	☐	_ _ _ _ _	64	☐	☐	☐	☐	_ _ _ _ _
15	☐	☐	☐	☐	_ _ _ _ _	40	☐	☐	☐	☐	_ _ _ _ _	65	☐	☐	☐	☐	_ _ _ _ _
16	☐	☐	☐	☐	_ _ _ _ _	41	☐	☐	☐	☐	_ _ _ _ _	66	☐	☐	☐	☐	_ _ _ _ _
17	☐	☐	☐	☐	_ _ _ _ _	42	☐	☐	☐	☐	_ _ _ _ _	67	☐	☐	☐	☐	_ _ _ _ _
18	☐	☐	☐	☐	_ _ _ _ _	43	☐	☐	☐	☐	_ _ _ _ _	68	☐	☐	☐	☐	_ _ _ _ _
19	☐	☐	☐	☐	_ _ _ _ _	44	☐	☐	☐	☐	_ _ _ _ _	69	☐	☐	☐	☐	_ _ _ _ _
20	☐	☐	☐	☐	_ _ _ _ _	45	☐	☐	☐	☐	_ _ _ _ _	70	☐	☐	☐	☐	_ _ _ _ _
21	☐	☐	☐	☐	_ _ _ _ _	46	☐	☐	☐	☐	_ _ _ _ _	71	☐	☐	☐	☐	_ _ _ _ _
22	☐	☐	☐	☐	_ _ _ _ _	47	☐	☐	☐	☐	_ _ _ _ _	72	☐	☐	☐	☐	_ _ _ _ _
23	☐	☐	☐	☐	_ _ _ _ _	48	☐	☐	☐	☐	_ _ _ _ _	73	☐	☐	☐	☐	_ _ _ _ _
24	☐	☐	☐	☐	_ _ _ _ _	49	☐	☐	☐	☐	_ _ _ _ _	74	☐	☐	☐	☐	_ _ _ _ _

PRINT OR TYPE

NAVY PHOTOGRAPHER'S MATE MODULE 3
NAVEDTRA 373-03-45-83

NAME ______________________________ ADDRESS ______________________________
Last First Middle Street/Ship/Unit/Division, etc.

____
City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ______________________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ______________ DATE MAILED ________

SCORE

1 T 2 F 3 4	1 T 2 F 3 4	1 T 2 F 3 4
1	26	51
2	27	52
3	28	53
4	29	54
5	30	55
6	31	56
7	32	57
8	33	58
9	34	59
10	35	60
11	36	61
12	37	62
13	38	63
14	39	64
15	40	65
16	41	66
17	42	67
18	43	68
19	44	69
20	45	70
21	46	71
22	47	72
23	48	73
24	49	74
25	50	75

PRINT OR TYPE

NAVY PHOTOGRAPHER'S MATE MODULE 3
NAVEDTRA 373-03-45-83

NAME ______________________________ ADDRESS ______________________________
Last First Middle Street/Ship/Unit/Division, etc.

____
City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ________________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ________________ DATE MAILED ________

SCORE

No.	1 T	2 F	3	4	No.	1 T	2 F	3	4	No.	1 T	2 F	3	4
1	☐	☐	☐	☐	26	☐	☐	☐	☐	51	☐	☐	☐	☐
2	☐	☐	☐	☐	27	☐	☐	☐	☐	52	☐	☐	☐	☐
3	☐	☐	☐	☐	28	☐	☐	☐	☐	53	☐	☐	☐	☐
4	☐	☐	☐	☐	29	☐	☐	☐	☐	54	☐	☐	☐	☐
5	☐	☐	☐	☐	30	☐	☐	☐	☐	55	☐	☐	☐	☐
6	☐	☐	☐	☐	31	☐	☐	☐	☐	56	☐	☐	☐	☐
7	☐	☐	☐	☐	32	☐	☐	☐	☐	57	☐	☐	☐	☐
8	☐	☐	☐	☐	33	☐	☐	☐	☐	58	☐	☐	☐	☐
9	☐	☐	☐	☐	34	☐	☐	☐	☐	59	☐	☐	☐	☐
10	☐	☐	☐	☐	35	☐	☐	☐	☐	60	☐	☐	☐	☐
11	☐	☐	☐	☐	36	☐	☐	☐	☐	61	☐	☐	☐	☐
12	☐	☐	☐	☐	37	☐	☐	☐	☐	62	☐	☐	☐	☐
13	☐	☐	☐	☐	38	☐	☐	☐	☐	63	☐	☐	☐	☐
14	☐	☐	☐	☐	39	☐	☐	☐	☐	64	☐	☐	☐	☐
15	☐	☐	☐	☐	40	☐	☐	☐	☐	65	☐	☐	☐	☐
16	☐	☐	☐	☐	41	☐	☐	☐	☐	66	☐	☐	☐	☐
17	☐	☐	☐	☐	42	☐	☐	☐	☐	67	☐	☐	☐	☐
18	☐	☐	☐	☐	43	☐	☐	☐	☐	68	☐	☐	☐	☐
19	☐	☐	☐	☐	44	☐	☐	☐	☐	69	☐	☐	☐	☐
20	☐	☐	☐	☐	45	☐	☐	☐	☐	70	☐	☐	☐	☐
21	☐	☐	☐	☐	46	☐	☐	☐	☐	71	☐	☐	☐	☐
22	☐	☐	☐	☐	47	☐	☐	☐	☐	72	☐	☐	☐	☐
23	☐	☐	☐	☐	48	☐	☐	☐	☐	73	☐	☐	☐	☐
24	☐	☐	☐	☐	49	☐	☐	☐	☐	74	☐	☐	☐	☐

PRINT OR TYPE

NAVY PHOTOGRAPHER'S MATE MODULE 3
NAVEDTRA 373-03-45-83

NAME ______________________________ ADDRESS ______________________________
Last First Middle Street/Ship/Unit/Division, etc.

____
City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ____________________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ____________________ DATE MAILED ________

SCORE

	1 T	2 F	3	4			1 T	2 F	3	4			1 T	2 F	3	4	
1	☐	☐	☐	☐	_____	26	☐	☐	☐	☐	_____	51	☐	☐	☐	☐	_____
2	☐	☐	☐	☐	_____	27	☐	☐	☐	☐	_____	52	☐	☐	☐	☐	_____
3	☐	☐	☐	☐	_____	28	☐	☐	☐	☐	_____	53	☐	☐	☐	☐	_____
4	☐	☐	☐	☐	_____	29	☐	☐	☐	☐	_____	54	☐	☐	☐	☐	_____
5	☐	☐	☐	☐	_____	30	☐	☐	☐	☐	_____	55	☐	☐	☐	☐	_____
6	☐	☐	☐	☐	_____	31	☐	☐	☐	☐	_____	56	☐	☐	☐	☐	_____
7	☐	☐	☐	☐	_____	32	☐	☐	☐	☐	_____	57	☐	☐	☐	☐	_____
8	☐	☐	☐	☐	_____	33	☐	☐	☐	☐	_____	58	☐	☐	☐	☐	_____
9	☐	☐	☐	☐	_____	34	☐	☐	☐	☐	_____	59	☐	☐	☐	☐	_____
10	☐	☐	☐	☐	_____	35	☐	☐	☐	☐	_____	60	☐	☐	☐	☐	_____
11	☐	☐	☐	☐	_____	36	☐	☐	☐	☐	_____	61	☐	☐	☐	☐	_____
12	☐	☐	☐	☐	_____	37	☐	☐	☐	☐	_____	62	☐	☐	☐	☐	_____
13	☐	☐	☐	☐	_____	38	☐	☐	☐	☐	_____	63	☐	☐	☐	☐	_____
14	☐	☐	☐	☐	_____	39	☐	☐	☐	☐	_____	64	☐	☐	☐	☐	_____
15	☐	☐	☐	☐	_____	40	☐	☐	☐	☐	_____	65	☐	☐	☐	☐	_____
16	☐	☐	☐	☐	_____	41	☐	☐	☐	☐	_____	66	☐	☐	☐	☐	_____
17	☐	☐	☐	☐	_____	42	☐	☐	☐	☐	_____	67	☐	☐	☐	☐	_____
18	☐	☐	☐	☐	_____	43	☐	☐	☐	☐	_____	68	☐	☐	☐	☐	_____
19	☐	☐	☐	☐	_____	44	☐	☐	☐	☐	_____	69	☐	☐	☐	☐	_____
20	☐	☐	☐	☐	_____	45	☐	☐	☐	☐	_____	70	☐	☐	☐	☐	_____
21	☐	☐	☐	☐	_____	46	☐	☐	☐	☐	_____	71	☐	☐	☐	☐	_____
22	☐	☐	☐	☐	_____	47	☐	☐	☐	☐	_____	72	☐	☐	☐	☐	_____
23	☐	☐	☐	☐	_____	48	☐	☐	☐	☐	_____	73	☐	☐	☐	☐	_____
24	☐	☐	☐	☐	_____	49	☐	☐	☐	☐	_____	74	☐	☐	☐	☐	_____
25	☐	☐	☐	☐	_____	50	☐	☐	☐	☐	_____	75	☐	☐	☐	☐	_____

PRINT OR TYPE

NAVY PHOTOGRAPHER'S MATE MODULE 3
NAVEDTRA 373-03-45-83

NAME ______________________________ ADDRESS ______________________________
Last First Middle Street/Ship/Unit/Division, etc.

____
City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ________________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ________________ DATE MAILED ________

SCORE

	1 T	2 F	3	4		1 T	2 F	3	4		1 T	2 F	3	4
1	☐	☐	☐	☐	26	☐	☐	☐	☐	51	☐	☐	☐	☐
2	☐	☐	☐	☐	27	☐	☐	☐	☐	52	☐	☐	☐	☐
3	☐	☐	☐	☐	28	☐	☐	☐	☐	53	☐	☐	☐	☐
4	☐	☐	☐	☐	29	☐	☐	☐	☐	54	☐	☐	☐	☐
5	☐	☐	☐	☐	30	☐	☐	☐	☐	55	☐	☐	☐	☐
6	☐	☐	☐	☐	31	☐	☐	☐	☐	56	☐	☐	☐	☐
7	☐	☐	☐	☐	32	☐	☐	☐	☐	57	☐	☐	☐	☐
8	☐	☐	☐	☐	33	☐	☐	☐	☐	58	☐	☐	☐	☐
9	☐	☐	☐	☐	34	☐	☐	☐	☐	59	☐	☐	☐	☐
10	☐	☐	☐	☐	35	☐	☐	☐	☐	60	☐	☐	☐	☐
11	☐	☐	☐	☐	36	☐	☐	☐	☐	61	☐	☐	☐	☐
12	☐	☐	☐	☐	37	☐	☐	☐	☐	62	☐	☐	☐	☐
13	☐	☐	☐	☐	38	☐	☐	☐	☐	63	☐	☐	☐	☐
14	☐	☐	☐	☐	39	☐	☐	☐	☐	64	☐	☐	☐	☐
15	☐	☐	☐	☐	40	☐	☐	☐	☐	65	☐	☐	☐	☐
16	☐	☐	☐	☐	41	☐	☐	☐	☐	66	☐	☐	☐	☐
17	☐	☐	☐	☐	42	☐	☐	☐	☐	67	☐	☐	☐	☐
18	☐	☐	☐	☐	43	☐	☐	☐	☐	68	☐	☐	☐	☐
19	☐	☐	☐	☐	44	☐	☐	☐	☐	69	☐	☐	☐	☐
20	☐	☐	☐	☐	45	☐	☐	☐	☐	70	☐	☐	☐	☐
21	☐	☐	☐	☐	46	☐	☐	☐	☐	71	☐	☐	☐	☐
22	☐	☐	☐	☐	47	☐	☐	☐	☐	72	☐	☐	☐	☐
23	☐	☐	☐	☐	48	☐	☐	☐	☐	73	☐	☐	☐	☐
24	☐	☐	☐	☐	49	☐	☐	☐	☐	74	☐	☐	☐	☐
25	☐	☐	☐	☐	50	☐	☐	☐	☐	75	☐	☐	☐	☐

PRINT OR TYPE

NAVY PHOTOGRAPHER'S MATE MODULE 3
NAVEDTRA 373-03-45-83

NAME ______________________________ ADDRESS ______________________________
Last First Middle — Street/Ship/Unit/Division, etc.

____
City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ________________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ________________ DATE MAILED ________

SCORE

No.	1 T	2 F	3	4		No.	1 T	2 F	3	4		No.	1 T	2 F	3	4	
1	☐	☐	☐	☐	_____	26	☐	☐	☐	☐	_____	51	☐	☐	☐	☐	_____
2	☐	☐	☐	☐	_____	27	☐	☐	☐	☐	_____	52	☐	☐	☐	☐	_____
3	☐	☐	☐	☐	_____	28	☐	☐	☐	☐	_____	53	☐	☐	☐	☐	_____
4	☐	☐	☐	☐	_____	29	☐	☐	☐	☐	_____	54	☐	☐	☐	☐	_____
5	☐	☐	☐	☐	_____	30	☐	☐	☐	☐	_____	55	☐	☐	☐	☐	_____
6	☐	☐	☐	☐	_____	31	☐	☐	☐	☐	_____	56	☐	☐	☐	☐	_____
7	☐	☐	☐	☐	_____	32	☐	☐	☐	☐	_____	57	☐	☐	☐	☐	_____
8	☐	☐	☐	☐	_____	33	☐	☐	☐	☐	_____	58	☐	☐	☐	☐	_____
9	☐	☐	☐	☐	_____	34	☐	☐	☐	☐	_____	59	☐	☐	☐	☐	_____
10	☐	☐	☐	☐	_____	35	☐	☐	☐	☐	_____	60	☐	☐	☐	☐	_____
11	☐	☐	☐	☐	_____	36	☐	☐	☐	☐	_____	61	☐	☐	☐	☐	_____
12	☐	☐	☐	☐	_____	37	☐	☐	☐	☐	_____	62	☐	☐	☐	☐	_____
13	☐	☐	☐	☐	_____	38	☐	☐	☐	☐	_____	63	☐	☐	☐	☐	_____
14	☐	☐	☐	☐	_____	39	☐	☐	☐	☐	_____	64	☐	☐	☐	☐	_____
15	☐	☐	☐	☐	_____	40	☐	☐	☐	☐	_____	65	☐	☐	☐	☐	_____
16	☐	☐	☐	☐	_____	41	☐	☐	☐	☐	_____	66	☐	☐	☐	☐	_____
17	☐	☐	☐	☐	_____	42	☐	☐	☐	☐	_____	67	☐	☐	☐	☐	_____
18	☐	☐	☐	☐	_____	43	☐	☐	☐	☐	_____	68	☐	☐	☐	☐	_____
19	☐	☐	☐	☐	_____	44	☐	☐	☐	☐	_____	69	☐	☐	☐	☐	_____
20	☐	☐	☐	☐	_____	45	☐	☐	☐	☐	_____	70	☐	☐	☐	☐	_____
21	☐	☐	☐	☐	_____	46	☐	☐	☐	☐	_____	71	☐	☐	☐	☐	_____
22	☐	☐	☐	☐	_____	47	☐	☐	☐	☐	_____	72	☐	☐	☐	☐	_____
23	☐	☐	☐	☐	_____	48	☐	☐	☐	☐	_____	73	☐	☐	☐	☐	_____
24	☐	☐	☐	☐	_____	49	☐	☐	☐	☐	_____	74	☐	☐	☐	☐	_____
25	☐	☐	☐	☐	_____	50	☐	☐	☐	☐	_____	75	☐	☐	☐	☐	_____

PRINT OR TYPE

NAVY PHOTOGRAPHER'S MATE MODULE 3
NAVEDTRA 373-03-45-83

NAME ______________________________ ADDRESS ______________________________
Last First Middle Street/Ship/Unit/Division, etc.

____
City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ________________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ________________ DATE MAILED ________

SCORE

	1 T	2 F	3	4			1 T	2 F	3	4			1 T	2 F	3	4	
1	☐	☐	☐	☐	_ _ _ _ _	26	☐	☐	☐	☐	_ _ _ _ _	51	☐	☐	☐	☐	_ _ _ _ _
2	☐	☐	☐	☐	_ _ _ _ _	27	☐	☐	☐	☐	_ _ _ _ _	52	☐	☐	☐	☐	_ _ _ _ _
3	☐	☐	☐	☐	_ _ _ _ _	28	☐	☐	☐	☐	_ _ _ _ _	53	☐	☐	☐	☐	_ _ _ _ _
4	☐	☐	☐	☐	_ _ _ _ _	29	☐	☐	☐	☐	_ _ _ _ _	54	☐	☐	☐	☐	_ _ _ _ _
5	☐	☐	☐	☐	_ _ _ _ _	30	☐	☐	☐	☐	_ _ _ _ _	55	☐	☐	☐	☐	_ _ _ _ _
6	☐	☐	☐	☐	_ _ _ _ _	31	☐	☐	☐	☐	_ _ _ _ _	56	☐	☐	☐	☐	_ _ _ _ _
7	☐	☐	☐	☐	_ _ _ _ _	32	☐	☐	☐	☐	_ _ _ _ _	57	☐	☐	☐	☐	_ _ _ _ _
8	☐	☐	☐	☐	_ _ _ _ _	33	☐	☐	☐	☐	_ _ _ _ _	58	☐	☐	☐	☐	_ _ _ _ _
9	☐	☐	☐	☐	_ _ _ _ _	34	☐	☐	☐	☐	_ _ _ _ _	59	☐	☐	☐	☐	_ _ _ _ _
10	☐	☐	☐	☐	_ _ _ _ _	35	☐	☐	☐	☐	_ _ _ _ _	60	☐	☐	☐	☐	_ _ _ _ _
11	☐	☐	☐	☐	_ _ _ _ _	36	☐	☐	☐	☐	_ _ _ _ _	61	☐	☐	☐	☐	_ _ _ _ _
12	☐	☐	☐	☐	_ _ _ _ _	37	☐	☐	☐	☐	_ _ _ _ _	62	☐	☐	☐	☐	_ _ _ _ _
13	☐	☐	☐	☐	_ _ _ _ _	38	☐	☐	☐	☐	_ _ _ _ _	63	☐	☐	☐	☐	_ _ _ _ _
14	☐	☐	☐	☐	_ _ _ _ _	39	☐	☐	☐	☐	_ _ _ _ _	64	☐	☐	☐	☐	_ _ _ _ _
15	☐	☐	☐	☐	_ _ _ _ _	40	☐	☐	☐	☐	_ _ _ _ _	65	☐	☐	☐	☐	_ _ _ _ _
16	☐	☐	☐	☐	_ _ _ _ _	41	☐	☐	☐	☐	_ _ _ _ _	66	☐	☐	☐	☐	_ _ _ _ _
17	☐	☐	☐	☐	_ _ _ _ _	42	☐	☐	☐	☐	_ _ _ _ _	67	☐	☐	☐	☐	_ _ _ _ _
18	☐	☐	☐	☐	_ _ _ _ _	43	☐	☐	☐	☐	_ _ _ _ _	68	☐	☐	☐	☐	_ _ _ _ _
19	☐	☐	☐	☐	_ _ _ _ _	44	☐	☐	☐	☐	_ _ _ _ _	69	☐	☐	☐	☐	_ _ _ _ _
20	☐	☐	☐	☐	_ _ _ _ _	45	☐	☐	☐	☐	_ _ _ _ _	70	☐	☐	☐	☐	_ _ _ _ _
21	☐	☐	☐	☐	_ _ _ _ _	46	☐	☐	☐	☐	_ _ _ _ _	71	☐	☐	☐	☐	_ _ _ _ _
22	☐	☐	☐	☐	_ _ _ _ _	47	☐	☐	☐	☐	_ _ _ _ _	72	☐	☐	☐	☐	_ _ _ _ _
23	☐	☐	☐	☐	_ _ _ _ _	48	☐	☐	☐	☐	_ _ _ _ _	73	☐	☐	☐	☐	_ _ _ _ _
24	☐	☐	☐	☐	_ _ _ _ _	49	☐	☐	☐	☐	_ _ _ _ _	74	☐	☐	☐	☐	_ _ _ _ _
25	☐	☐	☐	☐	_ _ _ _ _	50	☐	☐	☐	☐	_ _ _ _ _	75	☐	☐	☐	☐	_ _ _ _ _

PRINT OR TYPE

NAVY PHOTOGRAPHER'S MATE MODULE 3
NAVEDTRA 373-03-45-83

NAME ______________________________ ADDRESS ______________________________
Last First Middle Street/Ship/Unit/Division, etc.

____
City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ________________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ______________ DATE MAILED ________

SCORE

	1 T	2 F	3	4			1 T	2 F	3	4			1 T	2 F	3	4	
1	☐	☐	☐	☐	_____	26	☐	☐	☐	☐	_____	51	☐	☐	☐	☐	_____
2	☐	☐	☐	☐	_____	27	☐	☐	☐	☐	_____	52	☐	☐	☐	☐	_____
3	☐	☐	☐	☐	_____	28	☐	☐	☐	☐	_____	53	☐	☐	☐	☐	_____
4	☐	☐	☐	☐	_____	29	☐	☐	☐	☐	_____	54	☐	☐	☐	☐	_____
5	☐	☐	☐	☐	_____	30	☐	☐	☐	☐	_____	55	☐	☐	☐	☐	_____
6	☐	☐	☐	☐	_____	31	☐	☐	☐	☐	_____	56	☐	☐	☐	☐	_____
7	☐	☐	☐	☐	_____	32	☐	☐	☐	☐	_____	57	☐	☐	☐	☐	_____
8	☐	☐	☐	☐	_____	33	☐	☐	☐	☐	_____	58	☐	☐	☐	☐	_____
9	☐	☐	☐	☐	_____	34	☐	☐	☐	☐	_____	59	☐	☐	☐	☐	_____
10	☐	☐	☐	☐	_____	35	☐	☐	☐	☐	_____	60	☐	☐	☐	☐	_____
11	☐	☐	☐	☐	_____	36	☐	☐	☐	☐	_____	61	☐	☐	☐	☐	_____
12	☐	☐	☐	☐	_____	37	☐	☐	☐	☐	_____	62	☐	☐	☐	☐	_____
13	☐	☐	☐	☐	_____	38	☐	☐	☐	☐	_____	63	☐	☐	☐	☐	_____
14	☐	☐	☐	☐	_____	39	☐	☐	☐	☐	_____	64	☐	☐	☐	☐	_____
15	☐	☐	☐	☐	_____	40	☐	☐	☐	☐	_____	65	☐	☐	☐	☐	_____
16	☐	☐	☐	☐	_____	41	☐	☐	☐	☐	_____	66	☐	☐	☐	☐	_____
17	☐	☐	☐	☐	_____	42	☐	☐	☐	☐	_____	67	☐	☐	☐	☐	_____
18	☐	☐	☐	☐	_____	43	☐	☐	☐	☐	_____	68	☐	☐	☐	☐	_____
19	☐	☐	☐	☐	_____	44	☐	☐	☐	☐	_____	69	☐	☐	☐	☐	_____
20	☐	☐	☐	☐	_____	45	☐	☐	☐	☐	_____	70	☐	☐	☐	☐	_____
21	☐	☐	☐	☐	_____	46	☐	☐	☐	☐	_____	71	☐	☐	☐	☐	_____
22	☐	☐	☐	☐	_____	47	☐	☐	☐	☐	_____	72	☐	☐	☐	☐	_____
23	☐	☐	☐	☐	_____	48	☐	☐	☐	☐	_____	73	☐	☐	☐	☐	_____
24	☐	☐	☐	☐	_____	49	☐	☐	☐	☐	_____	74	☐	☐	☐	☐	_____
25	☐	☐	☐	☐	_____	50	☐	☐	☐	☐	_____	75	☐	☐	☐	☐	_____

PRINT OR TYPE

NAVY PHOTOGRAPHER'S MATE MODULE 3
NAVEDTRA 373-03-45-83

NAME ______________________________ ADDRESS ______________________________
Last First Middle Street/Ship/Unit/Division, etc.

____
City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ________________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ________________ DATE MAILED ________

SCORE

	1 T	2 F	3	4			1 T	2 F	3	4			1 T	2 F	3	4	
1	☐	☐	☐	☐	_____	26	☐	☐	☐	☐	_____	51	☐	☐	☐	☐	_____
2	☐	☐	☐	☐	_____	27	☐	☐	☐	☐	_____	52	☐	☐	☐	☐	_____
3	☐	☐	☐	☐	_____	28	☐	☐	☐	☐	_____	53	☐	☐	☐	☐	_____
4	☐	☐	☐	☐	_____	29	☐	☐	☐	☐	_____	54	☐	☐	☐	☐	_____
5	☐	☐	☐	☐	_____	30	☐	☐	☐	☐	_____	55	☐	☐	☐	☐	_____
6	☐	☐	☐	☐	_____	31	☐	☐	☐	☐	_____	56	☐	☐	☐	☐	_____
7	☐	☐	☐	☐	_____	32	☐	☐	☐	☐	_____	57	☐	☐	☐	☐	_____
8	☐	☐	☐	☐	_____	33	☐	☐	☐	☐	_____	58	☐	☐	☐	☐	_____
9	☐	☐	☐	☐	_____	34	☐	☐	☐	☐	_____	59	☐	☐	☐	☐	_____
10	☐	☐	☐	☐	_____	35	☐	☐	☐	☐	_____	60	☐	☐	☐	☐	_____
11	☐	☐	☐	☐	_____	36	☐	☐	☐	☐	_____	61	☐	☐	☐	☐	_____
12	☐	☐	☐	☐	_____	37	☐	☐	☐	☐	_____	62	☐	☐	☐	☐	_____
13	☐	☐	☐	☐	_____	38	☐	☐	☐	☐	_____	63	☐	☐	☐	☐	_____
14	☐	☐	☐	☐	_____	39	☐	☐	☐	☐	_____	64	☐	☐	☐	☐	_____
15	☐	☐	☐	☐	_____	40	☐	☐	☐	☐	_____	65	☐	☐	☐	☐	_____
16	☐	☐	☐	☐	_____	41	☐	☐	☐	☐	_____	66	☐	☐	☐	☐	_____
17	☐	☐	☐	☐	_____	42	☐	☐	☐	☐	_____	67	☐	☐	☐	☐	_____
18	☐	☐	☐	☐	_____	43	☐	☐	☐	☐	_____	68	☐	☐	☐	☐	_____
19	☐	☐	☐	☐	_____	44	☐	☐	☐	☐	_____	69	☐	☐	☐	☐	_____
20	☐	☐	☐	☐	_____	45	☐	☐	☐	☐	_____	70	☐	☐	☐	☐	_____
21	☐	☐	☐	☐	_____	46	☐	☐	☐	☐	_____	71	☐	☐	☐	☐	_____
22	☐	☐	☐	☐	_____	47	☐	☐	☐	☐	_____	72	☐	☐	☐	☐	_____
23	☐	☐	☐	☐	_____	48	☐	☐	☐	☐	_____	73	☐	☐	☐	☐	_____
24	☐	☐	☐	☐	_____	49	☐	☐	☐	☐	_____	74	☐	☐	☐	☐	_____
25	☐	☐	☐	☐	_____	50	☐	☐	☐	☐	_____	75	☐	☐	☐	☐	_____

PRINT OR TYPE

NAVY PHOTOGRAPHER'S MATE MODULE 3
NAVEDTRA 373-03-45-83

NAME ______________________________ ADDRESS ______________________________
Last First Middle Street/Ship/Unit/Division, etc.

____
City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ________________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ________________ DATE MAILED ________

SCORE

	1 T	2 F	3	4			1 T	2 F	3	4			1 T	2 F	3	4	
1	☐	☐	☐	☐	_____	26	☐	☐	☐	☐	_____	51	☐	☐	☐	☐	_____
2	☐	☐	☐	☐	_____	27	☐	☐	☐	☐	_____	52	☐	☐	☐	☐	_____
3	☐	☐	☐	☐	_____	28	☐	☐	☐	☐	_____	53	☐	☐	☐	☐	_____
4	☐	☐	☐	☐	_____	29	☐	☐	☐	☐	_____	54	☐	☐	☐	☐	_____
5	☐	☐	☐	☐	_____	30	☐	☐	☐	☐	_____	55	☐	☐	☐	☐	_____
6	☐	☐	☐	☐	_____	31	☐	☐	☐	☐	_____	56	☐	☐	☐	☐	_____
7	☐	☐	☐	☐	_____	32	☐	☐	☐	☐	_____	57	☐	☐	☐	☐	_____
8	☐	☐	☐	☐	_____	33	☐	☐	☐	☐	_____	58	☐	☐	☐	☐	_____
9	☐	☐	☐	☐	_____	34	☐	☐	☐	☐	_____	59	☐	☐	☐	☐	_____
10	☐	☐	☐	☐	_____	35	☐	☐	☐	☐	_____	60	☐	☐	☐	☐	_____
11	☐	☐	☐	☐	_____	36	☐	☐	☐	☐	_____	61	☐	☐	☐	☐	_____
12	☐	☐	☐	☐	_____	37	☐	☐	☐	☐	_____	62	☐	☐	☐	☐	_____
13	☐	☐	☐	☐	_____	38	☐	☐	☐	☐	_____	63	☐	☐	☐	☐	_____
14	☐	☐	☐	☐	_____	39	☐	☐	☐	☐	_____	64	☐	☐	☐	☐	_____
15	☐	☐	☐	☐	_____	40	☐	☐	☐	☐	_____	65	☐	☐	☐	☐	_____
16	☐	☐	☐	☐	_____	41	☐	☐	☐	☐	_____	66	☐	☐	☐	☐	_____
17	☐	☐	☐	☐	_____	42	☐	☐	☐	☐	_____	67	☐	☐	☐	☐	_____
18	☐	☐	☐	☐	_____	43	☐	☐	☐	☐	_____	68	☐	☐	☐	☐	_____
19	☐	☐	☐	☐	_____	44	☐	☐	☐	☐	_____	69	☐	☐	☐	☐	_____
20	☐	☐	☐	☐	_____	45	☐	☐	☐	☐	_____	70	☐	☐	☐	☐	_____
21	☐	☐	☐	☐	_____	46	☐	☐	☐	☐	_____	71	☐	☐	☐	☐	_____
22	☐	☐	☐	☐	_____	47	☐	☐	☐	☐	_____	72	☐	☐	☐	☐	_____
23	☐	☐	☐	☐	_____	48	☐	☐	☐	☐	_____	73	☐	☐	☐	☐	_____
24	☐	☐	☐	☐	_____	49	☐	☐	☐	☐	_____	74	☐	☐	☐	☐	_____
25	☐	☐	☐	☐	_____	50	☐	☐	☐	☐	_____	75	☐	☐	☐	☐	_____